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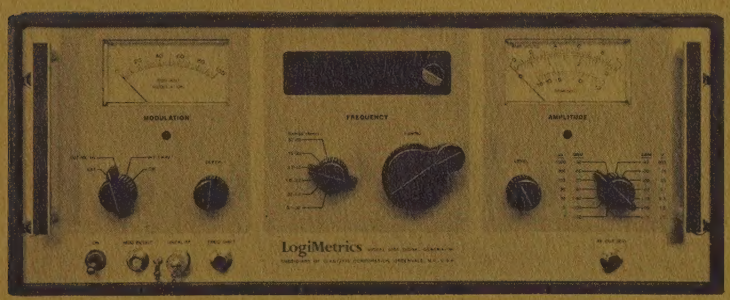
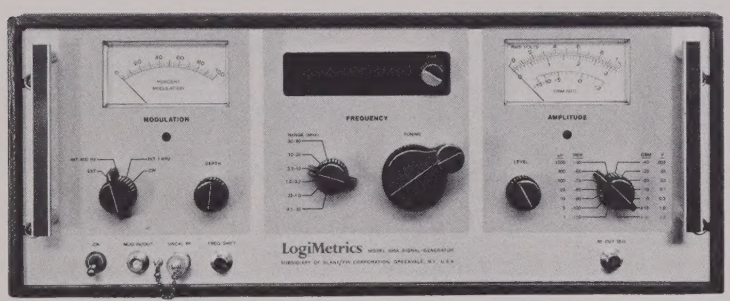
TECHNICAL MANUAL

SIGNAL GENERATOR MODEL 920A



LogiMetrics, INC.
100 Forest Drive at East Hills
Greenvale, New York 11548

TECHNICAL MANUAL



SIGNAL GENERATOR MODEL 920A

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The equipment described in this manual is protected by U.S. patent Nos. 3,488,605 and 3,509,484 and other U.S. and Foreign Patents pending.

LogiMetrics, INC.

100 Forest Drive at East Hills
Greenvale, New York 11548

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Figure 1-1. Model 920A Signal Generator

SECTION I
INTRODUCTION

1-1. GENERAL

1-2. This technical manual covers the installation, operation and maintenance of the Model 920A Signal Generator. The Model 920A Signal Generator, hereafter referred to as the Generator is manufactured by LogiMetrics, Inc., a subsidiary of the Slant/Fin Corporation, Greenvale, New York, 11548.

1-3. DESCRIPTION

1-4. The Generator, as shown in Figure 1-1, is a general purpose instrument, used for generating highly accurate CW or amplitude modulated signals over the 100 kHz to 80 MHz frequency range. This frequency range is covered in six overlapping bands. The frequency range of interest is selected by means of a Bandswitch on the front panel.

1-5. The Generator output signal is set to frequency by adjusting front panel tuning controls. The output frequency is displayed by a direct digital readout (ddc (tm), direct digital calibration). This system provides a continuous realtime calibration of the output frequency throughout the operating range of the Generator. The operator is thus provided with an illuminated digital front-panel readout of frequency with a resolution of up to 60 parts-per-million. The digital display provides a four digit frequency reading with automatic positioning of decimal point on all bands and at all settings of the tuning controls.

1-6. The Generator output signal may be a straight CW unmodulated r-f signal or modulated by internally or externally generated modulation signals. When internal modulation is selected the output signal can be modulated by a 400 Hz or a 1 KHz signal with a depth of modulation continuously variable from 0 - 95% and monitored by a front panel meter. The modulation signal selected is made available for external synchronization purposes at a BNC connector marked MOD IN/OUT. When the modulating signal is derived from an external source it is fed into this connector. The Generator will accept external modulation signals of 20 to 20,000 Hz; 3 volts rms are required for 95% modulation. Additional BNC signal input connectors on the front panel provide the means for inserting a remotely derived control signal for shifting the carrier frequency, and making available uncalibrated and calibrated output signals.

1-7. The calibrated output signal level is controlled by a switchable attenuator. At each attenuator setting of 1 uv to 3 volts, a level control provides the means for adjusting the output signal level from 10 to 100 percent of the value indicated by the attenuator switch setting. An output signal amplitude meter provides a convenient means for measuring the signal output level prior to attenuation, in terms of rms volts and dbm into 50 ohms.

1-8. The Generator is turned on and off by means of a power on-off switch located at the bottom left section of the front panel. The Generator operates from a 115 or 230 vac ±10% single phase power source of 50 to 400 Hz. A 115/230 vac slide switch on the Generator rear panel provides the means of setting the Generator for operation from either value of ac power.

1-9. The Generator front panel is divided into three functional sections; Modulation, Frequency, and Amplitude. This enables the operator to systematically concentrate on specific control areas when adjusting the parameters of the output signal. The mechanical design allows the Generator to be used as a bench-type or rack-mounted instrument.

1-10. TECHNICAL SPECIFICATIONS

1-11. Table 1-1 lists the technical specification of the Generator.

1-12. EQUIPMENT SUPPLIED

1-13. Table 1-2 lists equipment supplied with the Standard Model 920A Signal Generator.

Table 1-1. Technical Specifications

CHARACTERISTIC	SPECIFICATION
1. FREQUENCY:	
Range	100 KHz to 80 MHz
Calibration	Direct reading digital display readout
Accuracy	±0.006% of full scale (±60 ppm of a 4-digit scale)
Stability	Δf is typically less than 20 ppm per 10 minute period after warmup.
Fine Tuning	To 5 ppm
Frequency shift	External input control
2. MODULATION:	
Internal:	400 Hz and 1 KHz (±5%)
Modulation Depth	Continuously variable 0 to 95% to 1 v rms (3 volt range, max. p.e.p. is + 23 dbm)
Modulation Linearity	30% Modulation, less than 1% distortion. 70% Modulation, less than 3% distortion.
CW	No modulation.
External Modulation:	
Frequency	20 Hz to 20 KHz depending on carrier frequency.
Modulation Bandwidth	
Below 1 MHz	3.0 KHz at 30%, 1.5 KHz at 70%.
Above 1 MHz	20 KHz at 30%, 10 KHz at 70%.
Input voltage	3 volts rms into 600 ohms.
Monitor	Meter calibrated 0 to 100%. Accuracy ±5% of full scale.
3. AMPLITUDE (OUTPUT SIGNAL):	
Voltage Level	0.1 uv to 3.0 v rms into 50 ohms.
Power Level	-127 to +23 dbm.
Attenuation capability	140db (14 steps @ 10 db per step), plus 18 db continuously variable calibrated vernier.
Monitor	Three scales: 0 to 1 v rms; 0 to 3 v rms; and -15 to +3 db referenced to 0 dbm, 50 ohms.
Impedance	50 ohms, SWR less than 1.05 on 0.3 volt or less attenuator range, and less than 1.2 on higher ranges.

Table 1-1. Technical Specifications (Cont)

CHARACTERISTIC	SPECIFICATION
Output Leveling	Less than ±1/2 db with each frequency change within each band, and between bands.
Accuracy	Better than ±1 db at any frequency.
Uncalibrated output	100 mv rms CW signal.
4. FREQUENCY SHIFT CAPABILITY:	
Control Range	0.2% min. at high end of any band. 0.02% min. at low end of any band.
Input Voltage	+3 to +20 vdc.
Input Impedance	200 K ohms (nominal)
5. DISTORTION:	
Harmonic	At least 30 db below the carrier at output levels of 1 v or less.
Spurious AM	Hum and noise sidebands at least 70 db below carrier down to thermal noise threshold of 50 ohm system.
Residual FM	Typically less than ±1 ppm.
Incidental FM with 30% AM	Less than ±1 ppm.
6. MISCELLANEOUS	
RFI	Meets MIL-I-6181D permits receiver sensitivity measurements to 0.1 uv.
Operating Temperature	10° to 50° C.
Power Requirements:	
Line Voltage	115 vac (±10%), 230 vac (±10%)
Line Frequency	50 to 400 Hz.
Power	30 watts nominal.
Physical Dimensions:	
Cabinet	7 3/4 in. H X 19 3/4 in. W X 18 in. D.
Rack Panel	7 in. H X 19 in. W X 17½ in. D.
Weight	40 lbs. max., net. 65 lbs. max. shipping weight.

Table 1-2. Assemblies Supplied With Generator

ASSEMBLY REFERENCE DESIGNATION	NOMENCLATURE
100	Prescaler Circuits
200	Counter, Storage, and Display Circuits
300	Gate, Time, Logic Circuit
400	Modulator Circuit
500	Audio Circuits
600	Main Oscillator Circuits
700	High Level RF Amplifier Circuits
800	Power Supply Circuits
900*	Printer Driver Circuits
1000	Meter and Feedback Control Circuits
1100	Electronic Bandswitch

*optional

SECTION II
INSTALLATION

2-1. GENERAL

2-2. This section contains information necessary to installing the Generator. It provides instructions for preparing the instrument for use as well as repacking instructions.

2-3. UNPACKING AND INSPECTION

2-4. The Generator was inspected, tested, and calibrated for use prior to shipment. Inspect the shipping container for damage prior to opening the package and accepting it from the carrier. If damage to the container is evident open the package and inspect the instrument for damage. Report any damage observed to the carrier by listing the damage on the carriers receipt. A claim for damage, with a copy sent to LogiMetrics, must be filed within 15 days of receiving the instrument. When a claim is filed against the carrier, all packaging material must be held for inspection.

2-5. If the damage is not readily apparent until after the Generator is accepted, a claim for concealed damage must be filed with the carrier, with a copy to LogiMetrics, within 15 days following receipt of the instrument.

2-6. If the Generator is damaged in shipment, failure to file a claim against the carrier within the specified time, with a copy to LogiMetrics, may nullify the warranty in the event that damage is reported to LogiMetrics at a later date.

2-7. PREPARATION FOR USE

2-8. The Generator is shipped ready for use. Prior to installing it select a site which will allow several inches of clear space above the unit for cooling through natural air circulation. Refer to Figure 2-1 for detail outline dimensions of the instrument. If desired the Generator may be removed from its cabinet for rack mounting by removing the front panel retaining screws and rear hold-down screws and sliding the generator out of the cabinet. Place the panel chassis assembly into the rack and secure it to the rack with the retaining screws.

2-9. POWER REQUIREMENTS

2-10. The Generator is powered through a permanently connected line cord which is terminated by a three-prong ac plug. One prong of the ac plug is grounded to protect personnel from injury due to shock. If only a 2 contact ac outlet is available use an adapter and connect the green lead to ground to preserve the integrity of the protection feature. The Generator will operate from a power source of 115 vac or 230 vac (±10%) 50-400 Hz, single phase.

NOTE

When the Generator is shipped from the factory a 115/230 vac two position slide switch, located at the rear of the Generator, is set to the 115 v position. If operation from a 230 vac source is required set the slide switch to the 230 v position with the aid of a small screwdriver blade.

2-11. The same size fuse (0.5 ampere, slo-blo) is required for 115 vac or 230 vac operation. Never replace this fuse with a larger value.

2-12. SIGNAL CONNECTIONS

2-13. All input and output signal connections are made with BNC type connectors and 50 ohm coaxial cable such as RG-58/U or equivalent. Be sure that the connectors and cables are properly fabricated and that they are not shorted. To prevent signal losses do not use excessive lengths of cable.

NOTE

Output signals must be terminated in 50 ohms for the meter to read as calibrated.

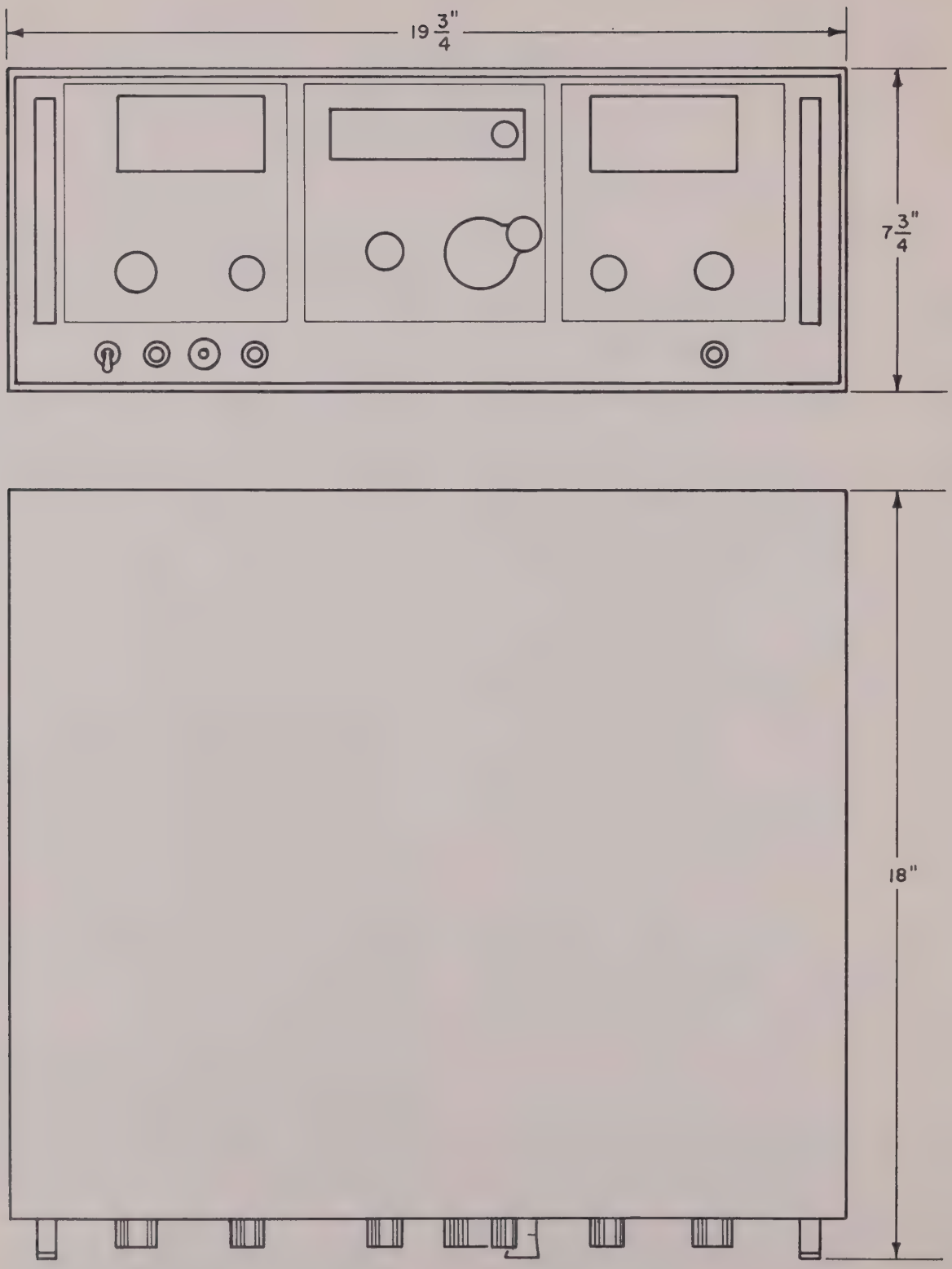

Figure 2-1. Model 920A Signal Generator, Outline Dimension Details

2-14. PACKING FOR RESHIPMENT

2-15. To repack the Generator for shipment use the original shipping container and packing materials since they were designed to accept the equipment and provide maximum protection during transit. If the original shipment materials have been discarded or are unfit for use, LogiMetrics will supply a new shipping container and packing materials upon request. In lieu of this procedure pack the Generator as follows:

a) Wrap the Generator in heavy kraft type wrapping paper. Be sure that the Generator is properly tagged indicating owner and return address, model number, serial number and a failure report or a note indicating the type of service requested.

b) Place the Generator in a strong corrugated carton capable of giving adequate protection during transit.

c) Pack sufficient shock absorbing material and dunnage around the Generator to prevent movement during transit. Place additional cardboard or shock absorbing air filled plastic material in front of the control panel to give additional protection to vulnerable parts.

d) Seal the shipping container securely making sure that all sides are closed.

e) Mark the shipping container "FRAGILE", or "DELICATE ELECTRONIC INSTRUMENT" to assure considerate handling by the carrier.

f) Address the label properly as follows:

TO: LogiMetrics, Inc.
Slant/Fin Corporation
100 Forest Drive
Greenvale, New York 11548

g) Prior to returning any instrument please request authorization from LogiMetrics. Refer to the Generator by model and serial number advising of the difficulty being experienced.

SECTION III
OPERATION

3-1. GENERAL

3-2. This section provides complete Generator operating instructions with an explanation of each operating control, connector, and indicator. It also includes basic operating procedures.

3-3. CONTROLS, INDICATORS, AND CONNECTORS

3-4. The operating controls indicators and connectors are all located on the front panel except for the 115/230 vac selector switch, and fuseholder, which are located on the rear chassis apron. Figure 3-1 illustrates the location of the front panel controls which are indexed to Table 3-1. This table lists each concontrol by its index number in Figure 3-1 and provides a functional description of each control, indicator, and connector.

3-5. TURN-ON PROCEDURE

3-6. To turn the generator on use the following procedure

Step 1. Be certain that the power switch is in the off position. Check that the position of the 115/230 volt ac switch at the rear of the Generator corresponds to the ac power source available. Refer to paragraph 2-9 for information about the power requirements.

Step 2. Connect the signal output and/or input cables as required for the application. Be sure to terminate the 50 ohm output in a 50 ohm resistive load.

CAUTION

Do not connect an RF or dc power source to the 50 ohm or UNCAL RF signal connectors. Doing so may cause damage to the Generator.

Step 3. Set the MODULATION selector to the CW position.

Step 4. Set the power switch to ON. The (ddc) digital frequency counter display will be lit. In addition the meter needles will move to the setting of their respective controls.

Step 5. Adjust the Generator controls for the mode of operation required as described in the following paragraphs. The front panel is functionally divided into three sections for convenience of operation (MODULATION, FREQUENCY, AMPLITUDE, from left to right). If the Generator frequency is to be shifted by an external input signal be sure that it is connected to the FREQ SHIFT connector.

NOTE

For best Generator operation attenuator settings should be made such that meter readings of 30 to 100 percent of full scale are obtained, except for meter readings below 0.3 uv. Thus when using the Generator it is advisable to use the highest output signal level possible and to reset the attenuator for major step changes.

3-7. CW MODE OPERATION

3-8. In the CW mode of operation the Generator delivers an unmodulated RF output signal whose level and frequency are determined by the settings of the front panel operating controls. CW operating procedures are as follows:

Step 1. Perform the turn-on procedure of paragraph 3-5.

Step 2. Set the MODULATION switch to the CW position.

Step 3. Set the RANGE (MHz) switch to the required band of frequencies.

Step 4. Tune the Generator to frequency using the TUNING crank for coarse adjustment and the FINE tuning control for fine adjustment. Observe the frequency reading on the digital display while tuning to frequency.

Step 5. Set the AMPLITUDE selector switch to the desired range.

Step 6. Set the output RF signal level available at the 50 ohm output connector by adjusting the LEVEL control. Read the output signal level on the AMPLITUDE meter.

Step 7. Recheck the readings on the AMPLITUDE meter and the digital frequency display. Trim the Generator controls if necessary.

3-9. INTERNAL MODULATION MODE

3-10. In the Internally Modulated Mode the output signal may be modulated by a 400 Hz or 1 KHz signal depending on the setting of the MODULATION selector switch. The output signal level, frequency and depth (percentage) of modulation are determined by the settings of the controls. The procedure for operating the Generator in the internally modulated mode is as follows:

Step 1. Perform the turn-on procedure of paragraph 3-5.

Step 2. Set the MODULATION selector switch to the INT 400 Hz or INT 1 KHz position, whichever is required.

Step 3. Set the RANGE (MHz) switch to the required band of frequencies.

Step 4. Tune the Generator to the frequency using the TUNING crank for coarse adjustment and the FINE tuning control for fine adjustments. Observe the frequency reading on the digital display while tuning to frequency.

Step 5. Set the AMPLITUDE selector switch to the desired range.

Step 6. Set the output RF signal level available at the 50 ohm output connector by adjusting the LEVEL control. Read the output signal level on the AMPLITUDE meter.

Step 7. Rotate the DEPTH control until the MODULATION meter reads the percentage of modulation desired.

Step 8. Recheck the readings on the meters and digital display. Trim the Generator controls if necessary.

3-11. EXTERNAL MODULATION MODE

3-12. The external modulation mode permits an external modulation signal of 20 Hz to 20 KHz to modulate the carrier frequency. The modulating frequency is injected into the MOD IN/OUT connector. Use the following procedure:

Step 1. Perform the turn-on procedure of paragraph 3-5.

Step 2. Set the MODULATION selector switch to EXT

Step 3. Adjust the DEPTH (percent) modulation control to the percentage of modulation desired.

Step 4. Set the RANGE (MHz) switch to the required band of frequencies.

Step 5. Tune the Generator to frequency using the TUNING crank for coarse adjustment and the FINE tuning control for fine adjustment. Observe the frequency reading on the digital display while tuning to frequency.

Step 6. Set the AMPLITUDE selector switch to the desired range.

Step 7. Set the RF signal level available at the 50 ohm output connector by adjusting the LEVEL control. Read the output signal level on the AMPLITUDE meter.

Step 8. Recheck the readings on the meters and digital display. Trim the Generator controls if necessary.

3-13. UNCALIBRATED RF SIGNAL

3-14. If the uncalibrated RF signal output, marked UNCAL RF on the front panel is required for test or other purposes connect a BNC terminated coaxial cable to the connector. Use the standard operating procedures for the particular mode of operation required as described in the above paragraphs. The uncalibrated RF output signal is a fixed level CW signal of 100 mv rms minimum.

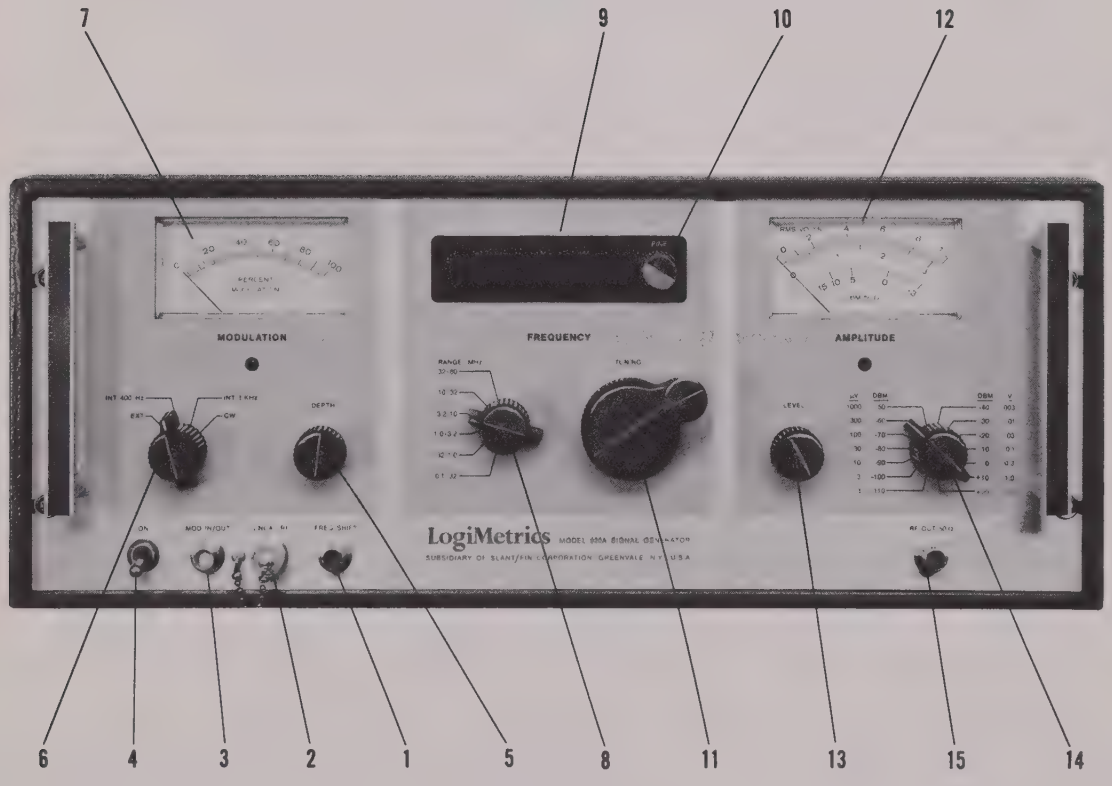

Figure 3-1. Location of Front Panel Controls, Indicators, and Connectors

Table 3-1. Function of Front Panel Controls, Indicators, and Connectors

FIGURE 3-1 INDEX NO.	NOMENCLATURE	FUNCTION
		Modulation (Left Front Panel)
1	FREQ. SHIFT	Provides for remote vernier control or NBFM of generated carrier. +3 to +20 vdc for full control 10 K ohms input impedance; dc coupled.
2	UNCAL RF	Provides an isolated and uncalibrated output signal from the main oscillator before modulation or final leveling. 100 mv rms nominal level; ac coupled.
3	MOD IN/OUT	Provides internal 400 Hz and 1 KHz modulation waveform for external purposes when internal 400 Hz or 1 KHz modulation is selected by Mode switch. Accepts modulating signals in 20 to 20,000 Hz range, 3 volts rms, maximum, when Mode switch is in EXT position.
4	ON	Power on-off switch energizes or deenergizes the Generator.
5	DEPTH	Provides means for adjusting percentage of carrier modulation. A single-turn continuous rotation control adjusts sinewave modulation depth from 0 to 95 percent.
6	(MODE SELECTOR) EXT, INT 400 Hz, INT 1 KHz, CW	A four position mode switch providing for capability of External Modulation, 400 Hz internal, 1 KHz internal, or CW (no modulation) of carrier signal.
7	PERCENT MODULATION	A modulation meter calibrated from 0 to 100 percent in 2-percent graduations. Monitors percentage of modulation of carrier signal when modulated by internal 400 Hz and 1 KHz signals as well as external signals in the 20 Hz to 20 KHz range.
8	RANGE (MHz)	A frequency range selector switch providing six positions one for each of the ranges (100 KHz to 320 KHz, 320 KHz to 1 MHz, 1 MHz to 3.2 MHz, 3.2 to 10 MHz, 10 MHz to 32 MHz, 32 MHz to 80 MHz).
9	FREQUENCY	A frequency monitor providing a four-digit Nixie display with automatically positioned decimal point and units (KHz or MHz) indication. A fifth digit (numeral one) is illuminated when frequency exceeds nominal upper limit on ranges 2 and 4.

Table 3-1. Function of Front Panel Controls, Indicators, and Connectors (Continued)

FIGURE 3-1 INDEX NO.	NOMENCLATURE	FUNCTION
10	FINE	Provides a means of fine tuning the carrier frequency. A single-turn continuous revolution control for vernier selection of frequency. Span of Fine control is a function of range and tuning settings.
11	TUNING	Provides a means for selection of any frequency within any of the six frequency range of the Generator. Furnishes a 27-turn continuous tuning capability within each range, with overlap beyond the nominal end frequencies, of each range.
12	AMPLITUDE RMS VOLTS, DBM 50 OHMS	An amplitude meter with three ranges calibrated in 0 to 1 v rms 0 to 3 v rms, and -15 to +3 dbm into 50 ohm. Measures calibrated 50 ohm Generator output signal amplitude when the Generator is terminated at a 50 ohm load.
13	LEVEL	Provides means for adjusting the voltage level of the calibrated output signal from 10 to 100 percent of the value indicated by the Amplitude LEVEL switch.
14	AMPLITUDE (Level Switch)	A fourteen position selectable precision attenuator switch providing 10 dB attenuation per step. Marked -110 to +20 dbm with corresponding voltage across 50 ohms also shown for monitor meter reading of full scale voltage.
15	RF OUT 50 OHMS	BNC connector provides calibrated RF output levelled or modulated signal from 50 ohm source up to 3-volt level.

SECTION IV
THEORY OF OPERATION

4-1. GENERAL

4-2. This section contains information relating to the theory of operation of the Model 920A Precision Signal Generator. The following discussion describes the overall theory of operation on a block diagram basis with additional paragraphs containing a description of the detailed circuit analysis.

4-3. OVERALL BLOCK DIAGRAM

4-4. As shown in the block diagram of Figure 4-1, the Generator is comprised of three main sections; namely the Oscillator Section, the Output Section, and the Digital Section.

4-5. The Oscillator Section contains two oscillators. An H.F. Oscillator generates the carrier frequency signal for Bands 1 to 5, and a VHF oscillator generates the carrier frequency signal for Band 6. The Oscillator Section also contains front panel controls and connectors which enable bandswitching, coarse and fine frequency tuning, the application of external frequency shift voltages from a remote source to the Generator, and the availability of an uncalibrated RF signal for external test, or measurement purposes. The Oscillator Section control functions appear under the designation of FREQUENCY on the Generator front panel.

4-6. The Output Section consists of Modulation and Amplitude circuits. Their control functions appear on the Generator front panel under MODULATION and AMPLITUDE sections. The Modulation Section provides the capability of applying internal, external, or no modulation signals (CW) to the carrier frequency by means of a mode selector switch on the front panel left hand side marked MODULATION. A percentage of modulation meter and a DEPTH control adjacent to this switch on the front panel permit the operator to monitor and adjust the depth of modulation whether applied from an internal or external source. Internal modulation sources of 400 Hz and 1 kHz, and external modulation sources of dc to 20 kHz depending on the carrier frequency, maybe used to modulate the Generator output signal. The Output Section also contains circuitry which permits the generated signal, modulated or not, to be leveled, amplified, and attenuated in accordance with the settings of the controls on the right hand side of the panel designated AMPLITUDE.

4-7. The Digital Section displays the Generator carrier frequency via a front panel numeric readout with appropriately placed decimal point and unit of frequency in kHz or MHz which are easily read from a normal viewing distance. The digital circuits use a precision 1 MHz clock, which employs a highly stable crystal oscillator, as a counting reference standard. The operation of the digital circuits is completely automatic since they are controlled by the settings of the bandswitch and tuning controls which determine the output frequency and thus the numeric readout of the digital display.

4-8. OSCILLATOR SECTION

4-9. As shown in Figure 4-2 two oscillator circuits are used to Generate the RF carrier signal depending on the frequency range. Bands 1-5 in the 100 kHz to 32 MHz frequency range employ an HF oscillator of the colpitts type which use a fixed inductor and a variable capacitor to determine the LC ratio and thus the output frequency. As each band is switched into place the inductance required for that band is connected across two-sections of the three-sections variable capacitor by the RANGE switch on the front panel. Band 6 in the 32-80 MHZ frequency range employs a VHF oscillator which employs the third section only of the three-section variable capacitor described above, and a permanently wired in inductor to form the tank of a completely separate oscillator whose circuit and LC ratio are designed for optimum performance in the 32-80 MHz VHF range. FINE tuning of each oscillator is achieved through vernier control of the voltage applied to varicap diodes in

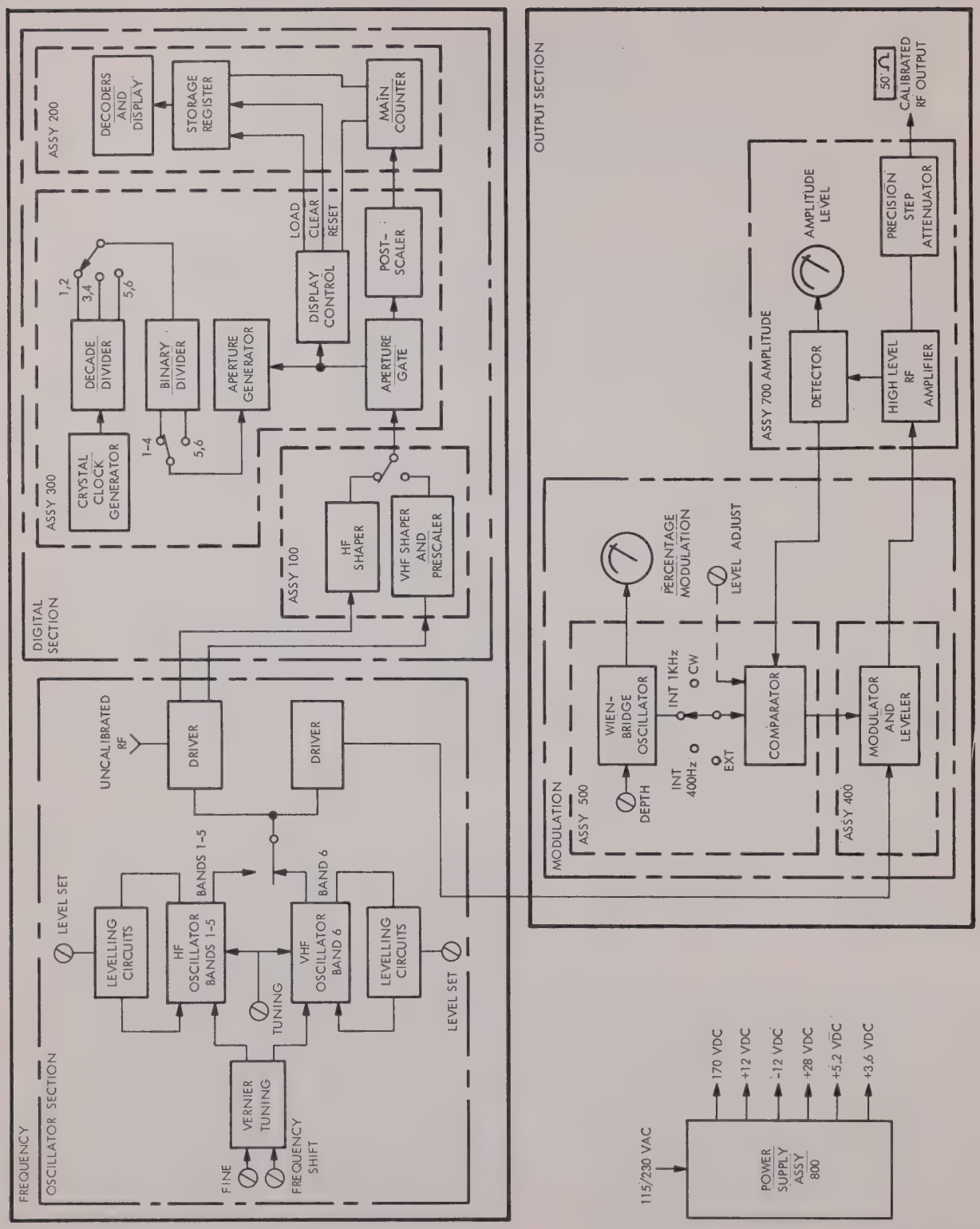

Figure 4-1. Model 920A Signal Generator, Overall Block Diagram

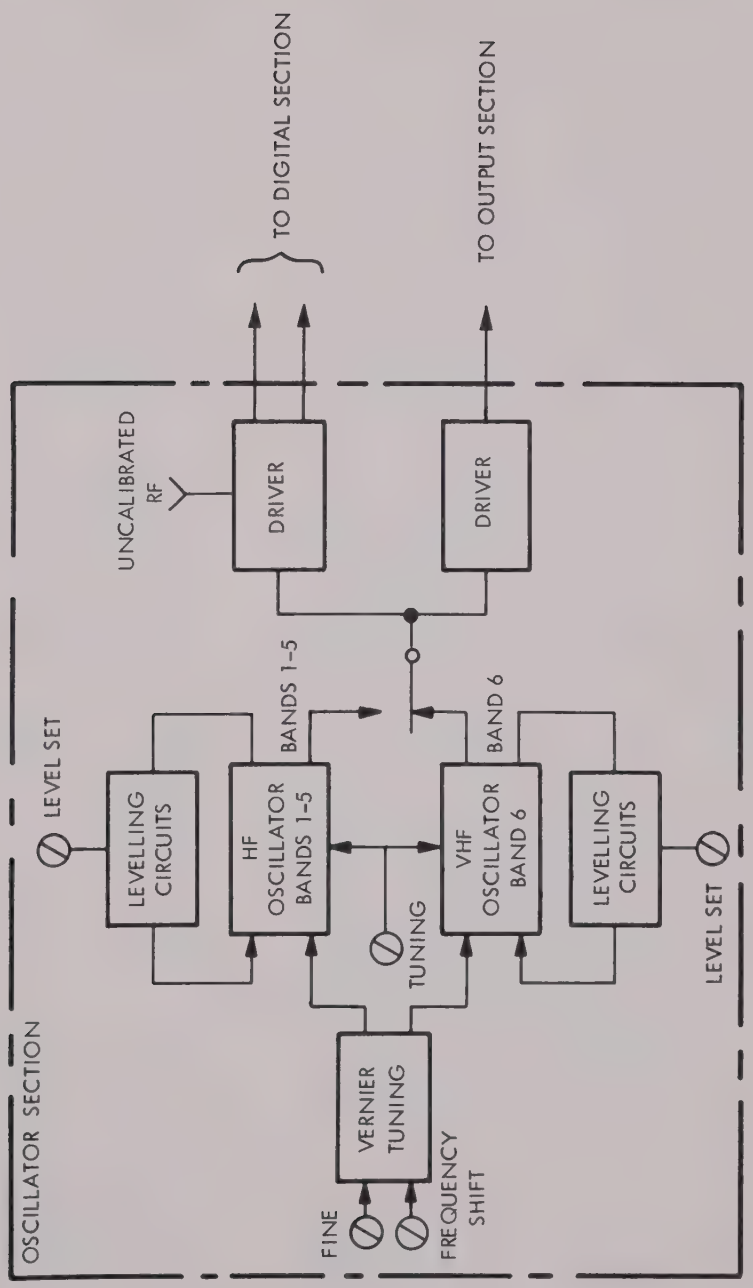

Figure 4-2. Oscillator Section, Block Diagram

the oscillator tank circuits. The voltage applied to these varicap diodes is derived from a bias supply whose voltage is varied by the FINE tuning control which is a potentiometer mounted on the front panel. The frequency can also be varied in fine increments by an external voltage applied to a frequency shift input connector (FREQ SHIFT) on the front panel for remote fine tuning of frequency shift. The diode used and bias voltage provided allows a frequency shift of .02 to 0.2 percent depending on the setting of the main tuning capacitor and the frequency band. Shift is greatest at the higher frequencies and at the high end of each band. Each oscillator employs its own detection and leveling circuitry, and is automatically disabled when it is not in use. Relay K601 which is activated or deenergized by means of contacts on the bandswitch connects the oscillator in use to the oscillator drivers. The leveling of the oscillator output signals is achieved through the use of signal diode detector circuits which detect the output signal and feed a corresponding portion back to the oscillator as required to maintain the oscillator output signal level at a constant value regardless of frequency. The HF oscillator employs diodes CR602 and CR603, while the VHF oscillator employs diodes CR604 and CR605 in this AGC application. The level of each oscillator is basically set at 50m V by initial adjustment of Level Calibration potentiometers. The oscillators are described in more detail in paragraph 4-20. The major portion of the oscillator circuits are contained on P.C. Assembly 600A. The oscillator circuit(s) outputs, are fed to both the Digital and Output (modulation) Sections through driver circuits. An uncalibrated RF signal is also made available for external use through a front panel BNC connector. The drivers act to isolate the functions from the oscillators and from one another in order to reduce spurious signal content and incidental AM and FM components in the generated signal.

4-10. OUTPUT SECTION

4-11. The Output Section as shown in Figure 4-3 provides for the Modulation and amplitude functional requirements. The operating controls for these functions are contained on the Generator left and right front panels which are marked accordingly. The Modulation circuits receive an RF carrier from the oscillator circuit in use through driver Q605 and through associated circuit components and cabling.

4-12. The RF carrier signal developed in the oscillator section is fed to the input of the "Modulator and Leveler", a dual gate FET amplifier in P.C. Assembly 400. The RF output signal is fed to Gate #1 of the FET and a control signal is fed to Gate #2. Thus the "Modulator and Leveler" is essentially a variable gain RF amplifier comprising one component of a four element closed loop system. This system consists of the "Modulator and Leveler", a fixed gain RF amplifier, an RF detector, and an operational amplifier comparator. The RF amplifier and detector circuits are on P.C. Assembly 700, while the comparator is located in P.C. Assembly 500 which also contains the Wien-bridge audio oscillator described in the following paragraphs. The amplified RF signal from the output of the "RF Amplifier" is fed to the "Detector" which provides a DC level corresponding to the RF Signal Amplitude. The detector output, containing both amplitude and modulation information, is fed through Assembly 1000 to form an input to a Comparator whose input is a DC voltage representing the RF level set by the level control on the front panel. When a modulating signal is required, the modulating signal is superimposed on the level voltage applied to the comparator. The comparator is a highly linear operational amplifier mainly because of the large amount of feedback around its amplifying element. It acts to subtract, and thereby compare, the RF level and modulation desired, with the RF level developed by the RF amplifier. The error signal is then applied as a correction signal to the modulator/leveler thereby creating a closed-loop feedback servo system which produces an RF signal having precise amplitude and modulation, or envelope, characteristics.

4-13. The RF output level is set by use of a potentiometer creating a DC reference for the "comparator". The level produced is monitored by the use of a DC microammeter operating as a voltmeter and connected across the detector. The RF output signal, after leveling and modulation have been applied, is passed through a precision decade RF attenuator to the RF OUT 50 OHM output BNC connector on the front panel. This attenuator in conjunction with the LEVEL control and the AMPLITUDE monitor enables the RF output to be set precisely. The AMPLITUDE monitor meter is calibrated in both voltage and decibel scales for this purpose. Two voltage scales are provided; 0-1 and 0-3 scales marked in units of rms voltage.

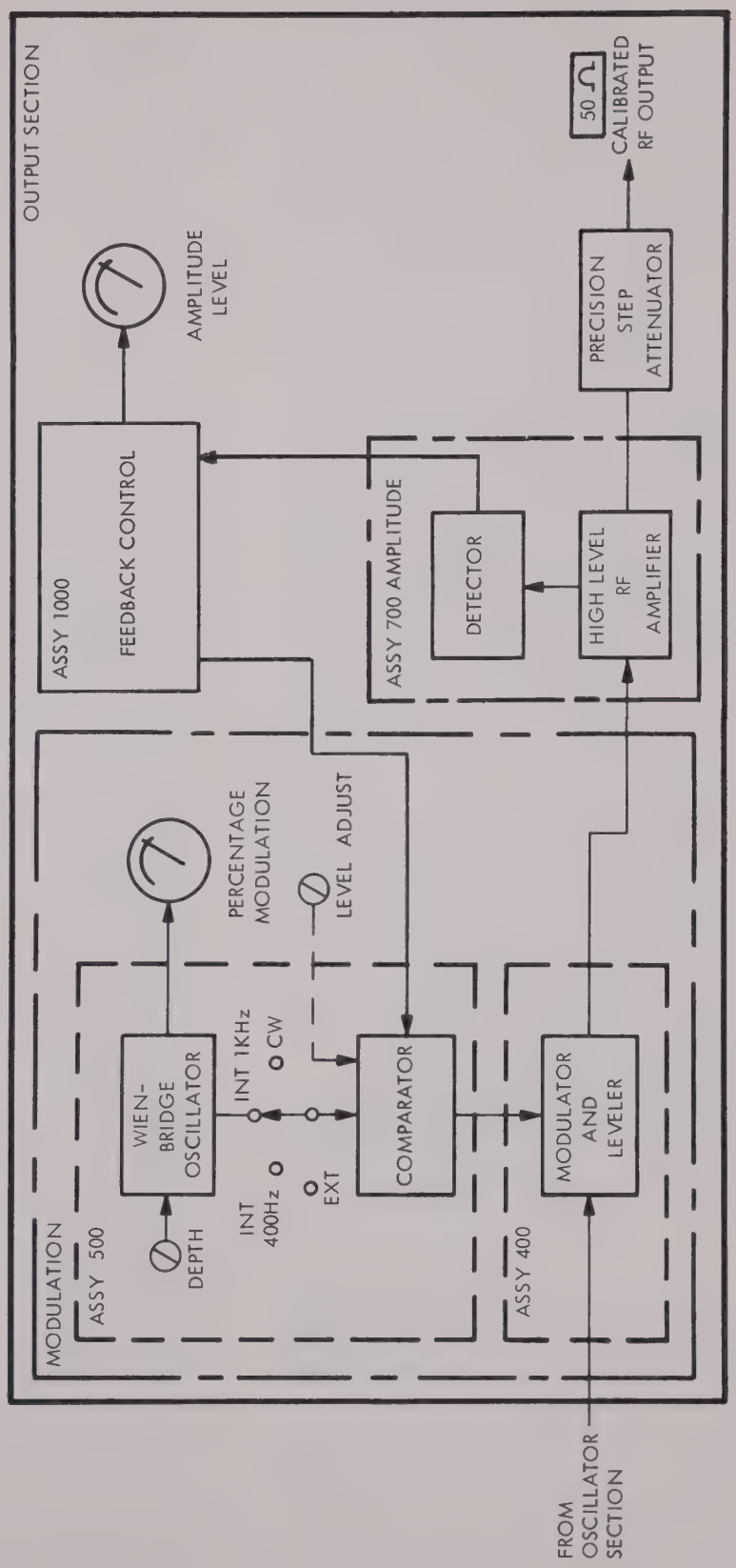

Figure 4-3. Output Section, Block Diagram

4-14. The internal modulation is supplied by a Wien-bridge oscillator; which as described earlier is on P.C. Assembly 500. A 400 Hz or 1 kHz modulating sinewave can be obtained by switching the front panel modulation selector accordingly. The Wien-bridge oscillator output is amplified to a level set by the front panel modulation "DEPTH" control. The amplified modulation signal is mixed with the RF level reference described above and applied to one input of the comparator. Prior to mixing, the modulation signal is detected and applied to a microammeter calibrated in percent modulation to indicate the percentage of AM modulation of the carrier signals. In addition, the audio oscillator signal frequency output is made available via the front panel MOD IN/OUT BNC connector. When the 400 Hz or 1 kHz internal modulating signal is selected it is routed to this jack for monitoring, or for synchronization of external equipment. When the modulation selector is set to the EXT position, the Wien-bridge oscillator is disconnected permitting external modulation of the Generator. The MOD IN/OUT connector is then connected to the modulator's audio amplifier and can be used for the application of external modulating signals in the 20-20,000 Hz range.

4-15. DIGITAL SECTION

4-16. The digital display portion of the Generator as shown in Figure 4-4, provides a numerical readout of the generated frequency. It employs digital logic whose counting circuits and techniques provide a flicker-free and non-ambiguous display. The decimal point position, units (kHz, MHz) indicators, and counting gate waveforms are all automatically adjusted as the frequency Bandswitch is rotated. To provide a digital readout with the required resolution at least four significant digits of the generated frequency are displayed in correct format. The digital circuits are located on P.C. Assemblies 100, 200, 300, and 1100.

4-17. As shown in Figure 4-4, the HF and VHF RF signals developed in the Oscillator Section are fed to respective HF and VHF Shaper circuits, consisting of limiters and schmitt triggers which form square-wave pulses of the format required to trigger the counters. These pulses appear at a rate to which the Generator Frequency is set and are fed to an aperture gate at the same time. The aperture is a rectangular waveform of precisely known duration as shown in Table 4-1, that allows the display counter to accumulate pulses totalling a decade submultiple of the frequency being generated at the moment. A 1 MHz Crystal Clock Generator provides the clock reference standard. This 1 MHz signal shaped by a schmitt trigger has output pulses which are fed to a number of decade and binary dividers. The exact number of decade and binary dividers switched in at a given time depends on the Generator frequency and thus the setting of the Bandswitch. The Bandswitch contacts connect or disconnect suitable dividers into the circuit. The output pulse train of these dividers are used to generate aperture pulses which are fed to one input of the aperture gate. The other input to the aperture gate is received from the HF or the VHF shaper circuit. When the window of the aperture gate is open, pulses from the shaper circuits can pass through the gate to be accumulated by the main counter. When the window closes there is no output from the aperture gate. Ten microseconds later the output of the aperture generator which also feeds the display control or programmer circuit causes the programmer to produce three sequential pulses (clear, load, and reset). The first pulse clears the storage register of the previous count; the second pulse loads the accumulated count from the main counter into the storage register; and the third pulse resets the main counter to zero in preparation for the next counting interval. The storage register feeds the decoders which use the counter BCD information to energize the proper numeric digital display numerals. The counter is updated a minimum of 25 times a second giving sufficient response to track the most rapid changes in frequency. Table 4-1 lists the various parameters of the aperture waveform for each band switch position. Parameters include Clock Decade Division Factor, Binary Division Factor, Aperture Width, Nominal Range Edge Frequency, AP-Gated RF Pulse Rate, Pulses to Post-AP Divider, Pulses to Display Counter, and the frequency range displayed at the various bandswitch positions.

4-18. P.C. ASSEMBLY DESCRIPTIONS

4-19. The Generator functions are readily traceable in most cases to their respective printed circuit boards. There are ten P.C. boards as described in the following paragraphs. Reference is made to chassis-mounted components or to other circuit boards when necessary.

4-20. MAIN OSCILLATOR - P.C. ASSEMBLY 600A

4-21. Assembly 600 contains the HF and VHF oscillator circuits that generate the RF signal,

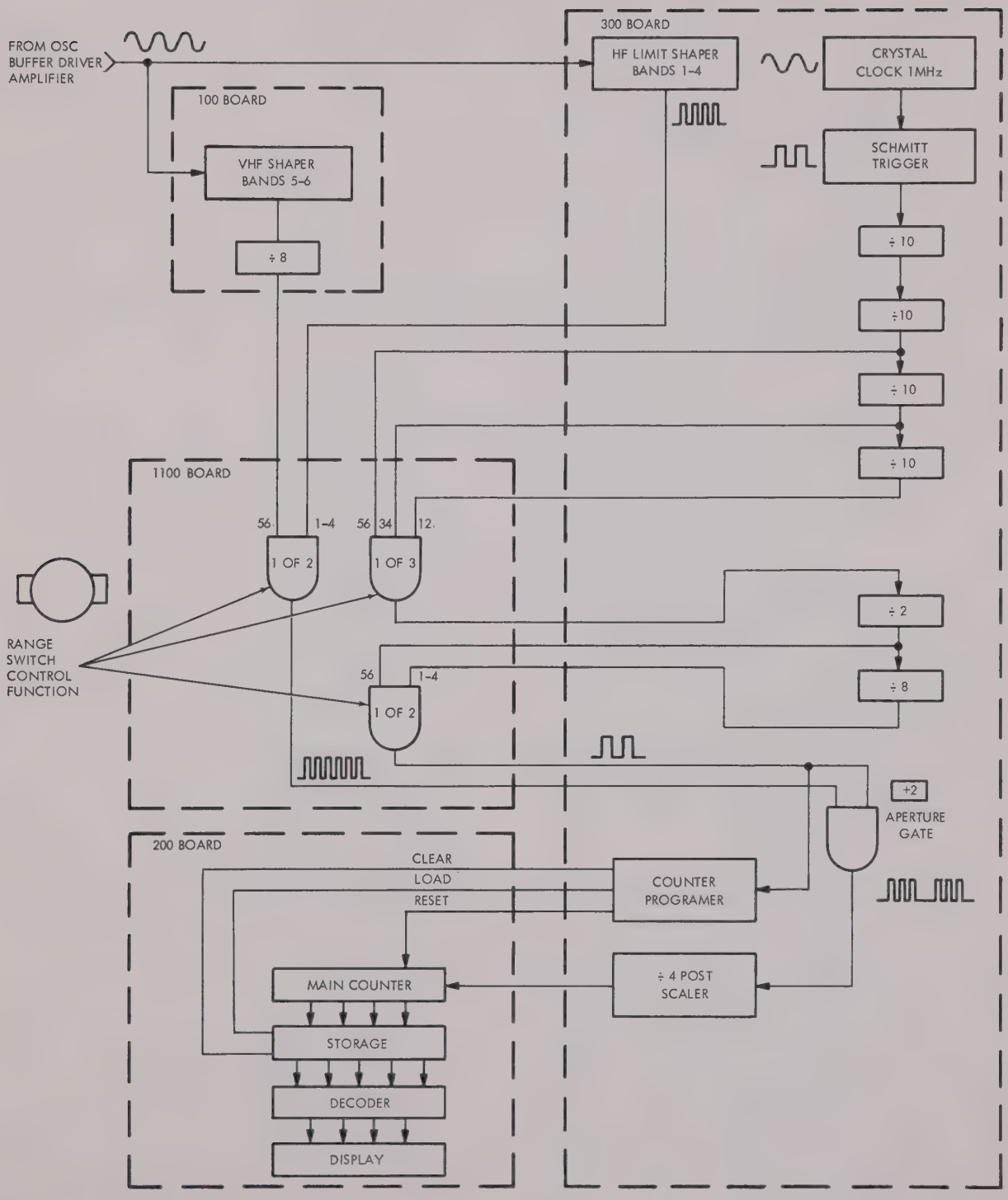

Figure 4-4. Digital Section, Block Diagram

Table 4-1. Aperture Generation/Counted RF Pulses vs Bandswitch Positions

1	2	3	4	5	6	7	8	9
Bandswitch Range Pos.	Clock Decade Division Factor	Clock Binary Division Factor	Resulting Aperture Width in Seconds	Nominal Range edge Freq.	Ap-Gated RF pulse rate	Pulses to Post-AP Divider (col 4 x col 6)	Pulses to Display Ctr $\frac{\text{col 7}}{4}$	Display as:
1	10,000	4	0.04	100 kHz 320 kHz	100 kpps 320 kpps	4,000 12,800	1,000 3,200	100.0 kHz 320.0 kHz
2	10,000	4	0.04	320 kHz 1000 kHz	320 kpps 1000 kpps	12,800 40,000	3,200 10,000	320.0 kHz 1000.0 kHz
3	1,000	4	0.004	1 MHz 3.2 MHz	1 Mpps 3.2 Mpps	4,000 12,800	1,000 3,200	1.000 MHz 3.200 MHz
4	1,000	4	0.004	3.2 MHz 10.0 MHz	3.2 Mpps 10.0 Mpps	12,800 40,000	3,200 10,000	3.200 MHz 10.000 MHz
5	100	32	0.0032	10.0 MHz 32.0 MHz	1.25 Mpps* 4.00 Mpps*	4,000 12,800	1,000 3,200	10.00 MHz 32.00 MHz
6	100	32	0.0032	32.0 MHz 80.0 MHz	4.00 Mpps* 10.0 Mpps*	12,800 32,000	3,200 8,000	32.00 MHz 80.00 MHz

*Pre-scaler division-by-eight used in ranges 5 and 6

and the drivers which isolate the oscillators from the effects of subsequent signal processing. Figure 6-8. illustrates the electrical and mechanical layout of P.C. Assembly 600. The HF oscillator operates when band 1 through 5 operation is selected. The HF oscillator comprises circuitry including transistors Q601, Q602, and Q603, and chassis-mounted inductors L601 through L605. The oscillator is of the Colpitts type and uses a dual-gate FET (Q601) as the active element. Two sections of a three-section variable capacitor are used as the center-tapped capacitor for the Colpitts configuration; five fixed inductors are sequentially switched across the capacitor sections to increase the frequency of oscillation in accordance with the range switch settings. The oscillator is levelled by a local feedback loop before its output is applied to the drivers.

4-22. RF energy developed across R605 in the Q601 FET drain circuit is applied via equalization circuit R606, R607, and C602 to one side of the tapped oscillator tank circuit. Out-of-phase energy is taken from the opposite side of the tank circuit and applied to a gate of Q601 via C601 in order to sustain oscillation, and to the emitter follower circuit Q603. The emitter follower provides a low driving impedance for the detector circuit that develops the levelling voltage for Q601. Diodes CR602 and CR603 form a biased detector that converts oscillator energy to a DC levelling command for application via voltage amplifier Q602 to the other gate of Q601. CR603 is biased by adjustable voltage divider R601-R645 to set the DC level developed from the RF output of Q603 and, hence, from the oscillator itself. The DC levelling voltage, filtered by C613 and C614, is inverted by Q602 and applied to a Q601 gate. If the oscillator RF output increases for any reason, the collector output of Q602 will bias Q601 reducing the drain current and thereby reducing the energy supplied to the tank circuit.

4-23. The RF output of the HF oscillator is taken from the emitter of Q603 and applied to driver Q604 circuit via N.C. contacts of reed relay K601, except when its coil is energized by deck F of bandswitch S1. Two driver circuits isolate the oscillator from the effects of load variations and spurious signals. Driver Q604 is an emitter follower that supplies the counting circuits (to the limiter below 10 MHz and to the prescaler above 10 MHz) and the uncalibrated RF output of the Generator. Driver Q605, supplies the RF signal to the modulator where it is modulated and fed to the calibrated output of the generator.

4-24. Vernier fine tuning of the HF oscillator is provided by voltage-variable capacitor diode CR601. The diode is DC-isolated by C606 and C607 and appears across the terminals of the tank circuit. The capacitance of CR601 is small in comparison with C603, C604, and C605; variation of its value has a small effect on oscillator frequency and is therefore useful for fine adjustments of the frequency. The capacitance of CR601 is varied by changing its bias voltage. R647 and R608 form a variable voltage divider that supplies bias to CR601 through isolation resistors R609 and R610. External bias may be applied to CR601 through R626 via the frequency shift input of the Generator. A remote vernier or an NBFM capability is thereby provided.

4-25. The VHF oscillator operates when the highest frequency range (Band 6) is selected. This oscillator comprises Q606, Q607, and Q608 and the associated circuitry. The operation is identical to that described above for the HF oscillator except that RF feedback to sustain oscillation is provided by a capacitance tap across the tank. A separate section of the tuning capacitor, C605C, is used for the VHF tank. RF energy from Q608 is applied to drivers Q604 and Q605 when the coil of K601 is energized. Deck F of bandswitch S1 energizes this relay as well as the entire VHF oscillator when the top range is selected. It will be noted that power to the unused HF oscillator in this mode is removed by S1F so that RF from the unused oscillator is not present in the output of the Generator.

4-26. MODULATOR - P.C. ASSEMBLY 400 (Figure 6-6)

4-27. The circuits of P.C. Assembly 400 perform two functions: Modulation is performed if required, and amplitude levelling of the RF signal is performed with reference to its amplitude after final amplification of P.C. Assembly 700. The DC leveling voltage is developed on P.C. Assembly 700 and it is combined with modulating signals and compared against the desired RF level on P.C. Assembly 500. The combined DC and audio voltage is applied to one gate of Q401, a dual gate FET on P.C. Assembly 400, in order to adjust the RF signal applied to the other gate of Q401. The RF is supplied from Q605 of P.C. Assembly 600. The

levelled and modulated RF signal is taken from the drain of Q401 and applied to common emitter amplifier Q402 via emitter follower Q404. Q402 is stabilized by the feedback network consisting of R405, R406, and C404. The amplified RF is developed across R407 in the collector circuit of Q402. It is then developed across a low impedance by the action of driver Q403, which acts as an emitter follower. The RF signal is then applied via coaxial cable to the High-Level RF Amplifier, Assembly 700.

4-28. HIGH-LEVEL RF AMPLIFIER - P.C. ASSEMBLY 700 (Figure 6-9)

4-29. The RF signal, levelled and modulated by P.C. Assembly 400, is amplified to its highest output level by P.C. Assembly 700. The high-level amplifier supplies the RF to the 50 Ω output connector through the attenuator and to a detector. The detector provides DC proportional to the RF level and envelope for both the output level monitor meter and the levelling input on Assembly 500.

4-30. Transistors Q701, Q702, and Q703 form a high-level RF amplifier having a very low output impedance. Q701 operates in the common emitter mode and amplifies the RF signal received via cable from Q403 of P.C. Assembly 400. The collector output of Q701 is applied to the base of Q702 and after amplification to the base of the emitter follower Q703. RF negative feedback is summed with the input RF in Q701 and Q702 to maintain the Q703 emitter output at a constant level. An impedance match to the 50 ohm input of the attenuator is obtained by series output resistor R712. Short-circuit damage to Q703 is prevented by DC-blocking capacitor, C711.

4-31. A DC voltage proportional to the RF output signal from Q703 is developed by detector CR702. Diode CR702 is isolated from the output path by R711 and C710. The DC voltage developed across R715 and C712 is applied via the 1000 board to Assembly 500 for levelling and modulation purposes. This DC voltage also supplies the output level meter circuits on P.C. Assembly 1000.

4-32. AUDIO CIRCUITRY - P.C. ASSEMBLY 500

4-33. P.C. Assembly 500 generates the internal modulation, accepts external modulation, mixes the selected modulating signal with the detected output from the 700 assembly, and creates the composite modulating and levelling voltage for application to the modulator, Assembly 400.

4-34. Sinewave modulating signals of 400 Hz or 1 KHz are generated in integrated circuit A1, a Wien-bridge oscillator. The bridge is formed from the components shown to the right of the operational amplifier ICA1 in Figure 6-7. The series R-C and parallel R-C arms of the bridge contain resistors switched by S2A, and S2B; R506 and R507 are selected in the 400 Hz position of the S2 mode switch, R508 and R509 are selected in the 1 KHz position. A tungsten filament lamp I501 is used as a variable resistance in the bridge in order to maintain a constant output level from the oscillator. Potentiometer R518 adjusts the level so that slightly more than 100-percent modulation is produced when the DEPTH control is fully clockwise. When S2 is in either the EXT or CW position, the bridge is opened and no audio is generated. Switch deck S2C selects internal or external audio (or no audio, in the CW position) for application through the DEPTH control to one side of the RF signal LEVEL control. The RF signal LEVEL control is connected as a variable voltage divider between regulated +12 volts and -12 volts; the modulating audio is coupled by C508 and is superimposed on the DC level voltage in a manner so that, as the RF level is adjusted, the modulating signal is similarly varied to maintain a constant modulation depth.

4-35. The wiper of the RF level control presents a signal to operational amplifier integrated circuit A502. This signal is a combination of DC, representing the desired RF carrier level, and AC, the modulating function. The second input to A502 is the detected RF output from Assembly 700; this input represents the actual output level and modulation as it appears in the RF envelope. Amplifier A502 operates as a comparator and develops an error-correcting signal used to modulate the RF signal on Assembly 400. In this manner, both the RF level and envelope are maintained with high accuracy and quality at the output of the high-level RF amplifier. Detector CR501 provides DC proportional to modulation level for application to the modulation monitor meter. The meter is calibrated by adjusting potentiometer R520.

4-36. PRESCALER - P.C. ASSEMBLY 100 (Figure 6-3)

4-37. One of the two RF outputs from driver Q604 on the main oscillator assembly are

counted by the digital section of the Generator. This output goes to a low frequency limiter and a high frequency limiter, prescaler. It is limited and divided by a factor of eight on Assembly 100 before being gated and counted.

4-38. RF is applied to a three-stage limiter to shape and maintain the proper drive for the first flip-flop, A101, of the binary divider. Diodes CR101, 102, and 103 act as passive limiters by clipping the positive and negative portions of the RF waveform exceeding the non-conducting levels of the diodes. Transistors Q101, Q102, and Q103, also provide gain so that the subsequent stages produce greater limiting. The limiter output from the Q103 collector circuit is applied to flip-flop A101. CR104 is a clamp maintaining the input bias of A101 at a level determined by the voltage divider formed by R110 and R111. The three cascaded flip-flops, A101, 102, and 103, perform division by eight upon the limited RF pulse train from Q103. The lower-rate pulse train has its level translated by the Q104 circuitry in order to be compatible with a different series of digital integrated circuits used on the 200 assembly.

4-39. The divider circuits on Assembly 100 will set the highest pulse rate processed by the counter circuitry at 10 MHz (since the highest frequency generated by the 920A is 80 MHz); this is identical to the highest rate processed when the 100 assembly is bypassed (10 MHz) in band 5 and below.

4-40. GATE TIME LOGIC - P.C. ASSEMBLY 300 (Figure 6-5)

4-41. The gate time logic assembly generates the counter aperture, gates the RF or pre-divided RF by the aperture, divides the gated RF by a factor of four, and generates display control commands. In addition, this assembly contains a limiter that processes the RF below 10 MHz for use by the digital circuitry.

4-42. The aperture is developed by dividing the pulse rate obtained from a crystal oscillator. A 1 MHz AT-cut crystal (X301) is used for its inherent temperature stability and precision accuracy. The output from the oscillator's active element, Q301, is buffered by emitter follower Q302. The Q302 buffer supplies a quad 2-input NAND integrated circuit, A313, in a Schmitt trigger configuration. Four cascaded decade dividers follow the Schmitt trigger and effect division by a factor of 10,000. Each decade divider contains four flip-flops connected as a bi-quinary counter (a divide-by-two circuit followed by a divided-by-five circuit). Division by five is obtained from three flip-flops by feedback from the third to the first and by gating the third by an AND combination of the first and second. All logic in the 920A is of the NOR variety; the AND function is obtained by combinations of NOR circuits.

4-43. The output of the second, third, and fourth decades are used to create apertures of various durations. The pulse periods obtained from the three outputs are 0.1, 1.0, and 10 milliseconds; one of these is chosen by S1B, a deck on the bandswitch, for application to a binary divider. The binary divider further reduces the crystal clock pulse rate by factors compensating for the post-aperture divider and, above 10 MHz, for the division by eight on the 100 Assembly. Below 10 MHz, deck C of the bandswitch selects the divide-by-four output from the five flip-flops forming the binary divider; this creates an aperture passing four times as many pulses as the display counter receives, in order to compensate for the division-by-four action of the post-aperture divider. Above 10 MHz deck C selects the full division capability of the binary divider-a factor of 32 - in order to compensate the aperture for the combined effects of the divide-by-eight action of the prescaler and the divide by four post-aperture division factor. Table 4-1 lists the selected clock divider factors for each range switch setting and the pre-aperture and post-aperture RF pulse rates. For each of the possible cases cited it will be seen that the display counter accumulates a count equal to the most significant figures of the generated frequency. The proper decimal point location and units indication are activated by decks E and D of the bandswitch to create a completely defined display of generated frequency. The output of the binary divider has the correct duration but is a squarewave; a further division by two in the A311 IC creates a squarewave whose active half-period is the desired aperture. The low half-period level gates RF pulses from the HF limiter or VHF limiter and prescaler through the aperture gate, A320, for application to a post-aperture divider, A312.

4-44. The post-aperture divider consists of two flip-flops contained in IC A312. The outputs of these flip-flops are chosen so that the waveform from the second falls at the mid-point of each group of four pulses applied to the divider. The display counter will increment its count at frequencies mid-way between frequencies

represented exactly by the display. This creates a display with true roundoff capability; for instance; if the generated frequency is 3.23531 MHz, the display would indicate 3.235 MHz; if the frequency were changed to 3.23563 MHz, the display would indicate 3.236 MHz showing that the generated frequency is in fact nearer 3.236 MHz than 3.235 MHz. A timing diagram for the waveforms associated with the post-aperture divider is shown in Figure 4-5. Note that all flip-flops increment at the negative-going transistions of the input waveform. The required starting conditions for the A312 flip-flops are assured by resetting them 30 microseconds after the aperture ends.

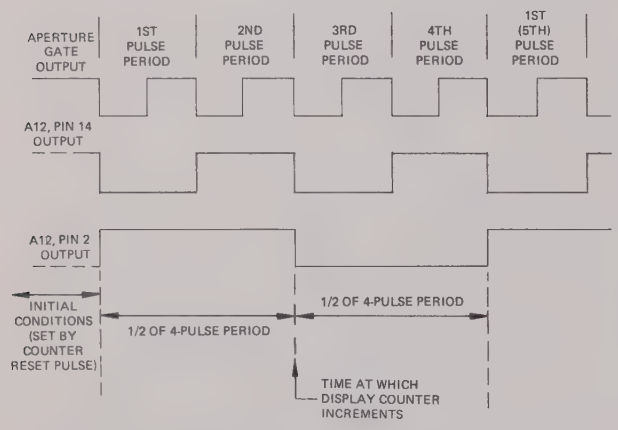
APERTURE GATE OUTPUT
1ST PULSE PERIOD
2ND PULSE PERIOD
3RD PULSE PERIOD
4TH PULSE PERIOD
1ST (5TH) PULSE PERIOD
A12, PIN 14 OUTPUT
A12, PIN 2 OUTPUT
INITIAL CONDITIONS (SET BY COUNTER RESET PULSE)
1/2 OF 4-PULSE PERIOD
1/2 OF 4-PULSE PERIOD
TIME AT WHICH DISPLAY COUNTER INCREMENTS

Figure 4-5. Post-Aperture Divider Waveforms

4-45. The aperture gating waveform generated in the A311 flip-flop (pin 13 output) is a square wave. The inactive period is of the same duration as that gating RF pulses to the post-aperture divider. At the end of the active period the count accumulated in the display counter is available for transfer to the display storage register. The register must first be cleared before transfer is effected; after transfer the counter must be cleared for accumulation of new frequency data during the next aperture period. The clear and transfer (load) commands are developed by the sequence timer. The timer consists of three single-shot multivibrators cascaded to produce three pulses spaced in time to allow the above-described sequence of operations to take place. The series of pulses is initiated at the end of the aperture gate period. When A311, pin 13, rises, the first single-shot MV, consisting of cross-coupled NOR circuits in A314, is triggered. After approximately 10 microseconds the single-shot MV reverts to its quiescent condition. A314 pin 3 goes negative; C307 acts as a differentiator and passes the negative transistion to gate-driver A318, which is wired as an inverter. The pin 3 output of A318 rises for several microseconds; the positive pulse thus produced is taken as the storage reset command and is also applied to the second single-shot MV. After ten additional microseconds A314, pin 5 reverts and its differentiated inverted output (from A318, pin 5) is used to trigger the third single-shot MV. The A318, pin 5, output is re-inverted for use as the storage load command by A319, pins 13 and 3. After an additional 10-microsecond delay A319, pin 5 produces a pulse used to reset the display counter and the post-aperture divider. The pulse sequence and its relation to the aperture gating waveform is shown in Figure 4-6.

4-46. COUNTER, STORAGE, AND DISPLAY — P.C. ASSEMBLY 200 (Figure 6-4)

4-47. This assembly counts the aperture-gated pulse train from the post-aperture divider, stores the resulting value in a register, and decodes and displays the stored value of generated frequency. The assembly contains the display, which consists of five Nixie® tube numeral display tubes and the units indicators — kHz and MHz. Decimal points for the display are contained within the Nixie® tubes and are controlled by the bandswitch, as are the units indicators.

4-48. The display counter is a group of cascaded decade dividers that maintain a one-to-one correspondence with significant digits of the frequency generated and its display. As in the case of the crystal clock decade dividers, the display counters are of the bi-quinary variety. Four groups of four flip-flops each accumulate (or count) the RF-pulses so that, at the end of each aperture period, the frequency value is held in the counter stages in a binary coded decimal (BCD) format with weights of 8, 4, 2 and 1 assigned to the flip-flop outputs in each decade. The last flip-flop of each decade group (A203, A205, A208, and A210) has weight eight. The fifth significant digit in the display is either zero or one; only one flip-flop is required (A211) and the zero is not displayed.

4-49. The accumulated count is transferred, or loaded, into a separate register so that the display counter will be free to count when the next aperture period begins. If a separate

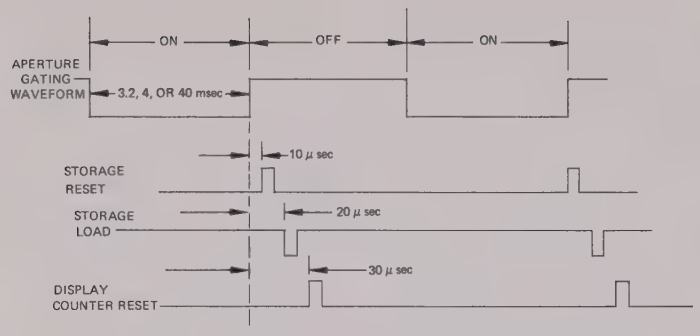

Figure 4-6. Display Control Timing Diagram

register were not used, the display would be correct for only half the time. The display would have to be either blanked or allowed to follow the counter as it accumulated pulses for the aperture period; this would result in a display with an annoying flicker. By use of the register, the display is inactive for only the time between the storage reset and load commands - ten microseconds. Figure 4-7 shows the time relationship between the displayed value and the counting period to which it refers. It will be seen that a value is displayed for only twice as long as it takes to count. This extremely short display period allows the 920A always to keep pace with rapidly changing frequency as occurs when the tuning knob is "twirled."

4-50. The count input from the post-aperture divider is applied to flip-flop A201, pin 2. The four flip-flops in A201 and A203, in conjunction with NOR circuits in A202, count the pulses in a decade divider configuration. The A203, pin 9 output is applied to the next decade, A204, A205 and half of A202. At the end of the aperture, the seventeen flip-flops (A201 through the first half of A211) contain the frequency value counted. This value is held by the counter until the storage register can be cleared of the value presently being displayed. The storage register consists of sixteen latches formed by cross-coupling NOR circuits in the quad-NOR IC's A216 through A223. The positive storage reset pulse forces each latch to create and hold a high level at its pin 14 or pin 8 output. Since the latches previously stored bits of the BCD coded count value, the old count value is removed and the 17-bit storage register is reset.

4-51. Ten microseconds later the storage load command pulse appears; this is a momentary low level and allows the storage gates in quad-NOR IC's A212 through A215 and flip-flop A211 (pin 9 out) to have high outputs if the corresponding input from the counter flip-flop is also low. The storage gates act to invert the BCD coded data from the counter, but the data are re-inverted by the action of the latches. The latch outputs (pin 14 or pin 8) are high for the 10-microsecond period between the storage reset and load commands. This is because the storage gate outputs (pins 3, 8, 14 and 5) are low due to the normally high level of the load command; also, the other input to the right half of each latch is low, since the reset command is high momentarily. (Two low inputs to a NOR circuit produce a high output.) The high latch output condition is fed back to its left half to maintain the state after the reset command pulse disappears. When the load command appears, a low counter flip-flop output will appear as a high input to the latch because of inversion in the gate circuit. A latch output will then go low only if its counter flip-flop is low; this condition is maintained until the next storage reset command appears. If a latch flip-flop is high when the load command appears, the latch will be presented with a low gated input and the latch will remain in its high reset condition. In this manner, the value held in the counter is loaded into the storage register. Ten microseconds later the counter flip-flops are reset so that a new value can be properly accumulated.

4-52. Integrated circuits A224 through A227 are BCD-to-ten-line decoders. That is a decimal value (0 through 9) presented to four inputs (pins 6, 7, 15 and 14) in a 8-4-2-1 code will cause one of ten output lines to be energized. Each permissible BCD input causes a different output line to be energized. The "false" outputs of the flip-flops in the display counter are

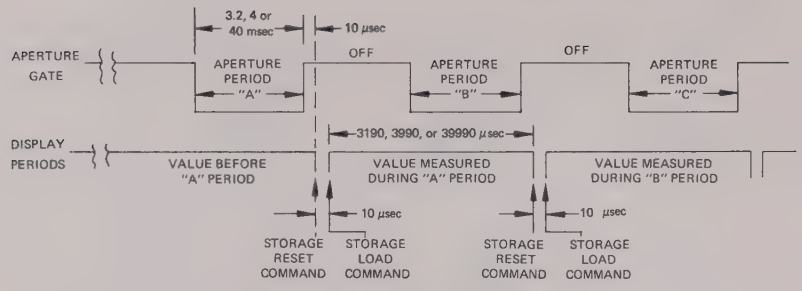

Figure 4-7. Display Period Related to Aperture Period

used by the decoders because of their internal circuit requirements; it is noted above that the combined effect of the load gates and storage register latches is to pass data without inversion. Thus the decoder input data is in negative-true format; that is low levels indicate "ones" and high levels are "zeroes."

4-53. The decoders contain high-voltage transistor outputs that can switch the +170 volt supply necessary for Nixie® operation. Each of the ten decoder outputs is wired to one of the ten numeral segments in its corresponding Nixie® V201 through V204. When energized, an output path consists of a transistor in its conducting state allowing current to flow from the +170 volt supply through the series current-limiting resistor, R201, R202, R203 or R204, through the Nixie® numeral and thence to ground through the transistor itself. The most significant digit is illuminated only when "1", flip-flop A211 (pin 9 out) acts by itself as a gate and latch. Its pin 9 output, when high, allows Q201 to conduct current through the numeral 1 segment of Nixie® tube V205.

4-54. POWER SUPPLY — P.C. ASSEMBLY 800 (Figure 6-10)

4-55. The power supply assembly develops regulated and unregulated voltages for the circuits within the 920A. A transformer with series-parallel primary windings allows operation from 115 or 230 volt sources; four secondaries supply power to six circuits on the 800 assembly that, in turn, supply unregulated +170 volts, and regulated −12, +3.6, +5.2, +12, and +28 volts. All six DC supplies are individually referred to ground. These supplies are described as follows:

a. -12 VOLT SUPPLY

Regulation for the -12 volt supply is provided by Zener diode CR814 and series dropping register R801.

b. +170 VOLT SUPPLY

This supply is used by the Nixie® display tubes and requires no regulation.

c. +12 VOLT SUPPLY

The +12 volt supply is closely regulated; it contains a Zener diode CR815, to establish a stable voltage reference. The regulated +12 volt level, referenced to CR815, is, in turn, used as a reference level for the +28, +5.2 and +3.6 volt regulators.
Q808 acts as a sensing amplifier comparing the reference voltage of CR815 in its emitter with the +12 volt output through the adjustable voltage divider R810, R811, and R812. The collector load of Q808, R807, is returned to the +28 volt supply. The Q808 output is applied to the base of the Darlington-connected Q805 Q806, in the Darlington configuration with Q805, is a series-pass transistor used to effect regulation of the +12 volt output. R809 is a series-wired current sensing resistor. If the +12 volt current becomes excessive, the drop across R809 will exceed the base-emitter turn-on level of Q807; Q807 will conduct and lower the input to Q805 and hence reduce the supply voltage because of the load resistor, R807, common to the Q808 and Q805 collectors.

d. +28 VOLT SUPPLY

This regulated supply operates in a manner similar to that of the +12 volt supply. The reference for the emitter of sensing amplifier Q804 is taken from the +12 volt output rather

than from another Zener diode. Output sensing voltage divider R805 and R806 employs precision resistors rather than an adjustable resistor.

e. +5.2 VOLT SUPPLY

Current-sensing and series-pass circuits Q812 and Q813 are placed in the grounded leg of this supply. Output voltage sensing is performed in a comparator amplifier formed from Q809 and Q810. The reference level is obtained from the +12 volt line through divider R818 and R819. The +5.2 volt output is sensed at the Q809 base. The comparator output signal developed across collector load R817 is applied to the base of Darlington-connected Q811.

f. +3.6 VOLT SUPPLY

This regulated supply is similar to the +5.2 volt supply. A lower reference is obtained by divider R827 and R828 connected across the +12 volt supply.

4-56. METER AND FEEDBACK CONTROL — P.C. ASSEMBLY 1000

4-57. The meter and feedback control P.C. Assembly 1000 circuits as shown in Figure 6-11 accept the detected RF signals from the 700A high level RF amplifier P.C. Assembly for application to the front panel AMPLITUDE meter and the comparator circuit in the 500 P.C. Board Assembly which provides the ALC signal to the modulator in P.C. Assembly 400. It also contains the potentiometers which provide the means for calibrating the front panel amplitude meter scales. R9 calibrates the 3 V meter scale, R8 calibrates the 1 V meter scale; and R10 calibrates the 3 V RF signal. In Bands 1 and 2 only, relay K1 is switched in to place capacitor C1 in the circuit to improve the response of the circuit to low frequencies. Relay K1 is activated or deactivated by the action of contacts on the Bandswitch.

4-58. ELECTRONIC BANDSWITCH — P.C. ASSEMBLY 1100 (Figure 6-5)

4-59. The 1100 assembly consists of three integrated circuits A1101, A1102, A1103. Each of which is a Quad 2 input NOR gate. This assembly is programmed by constant D.C. levels from the bandswitch. It performs the various gate-time and input selection functions described in 4-37 and 4-43.

SECTION V
MAINTENANCE

5-1. GENERAL

5-2. This section contains maintenance instruction and procedures for the Model 920A Signal Generator. It includes troubleshooting information and various adjustment procedures as required for proper maintenance of the Generator over a long period of time. Generally the Generator is maintenance free and requires no attention since it is self calibrated by means of the digital display. In addition, the signal amplitude, and modulation capability are also metered providing still another check of the output signal parameters. However, after an extended period of time, or should a malfunction occur the following troubleshooting and maintenance procedures should be followed.

5-3. PREVENTIVE MAINTENANCE

5-4. The Generator requires a minimum of preventive maintenance. For normal maintenance purposes check the crystal oscillator frequency and the power supply output voltages on an annual basis as described in the following paragraphs. While these checks or adjustments are being made, the interior of the Generator may be cleaned by blowing out any dust which may have accumulated. An air hose with approximately 20 pounds pressure may be used for this purpose. Be sure that the air is free of dirt or oil. Before performing any maintenance procedures or adjustments to the Generator become familiar with the procedure for disassembling and removing the Generator from its enclosure.

5-5. RECOMMENDED TEST EQUIPMENT

5-6. Table 5-1 contains a list of recommended test equipment. Equivalents may be used when necessary.

5-7. GENERATOR DISASSEMBLY PROCEDURE

5-8. To disassemble the Generator from its enclosure perform the following procedure.

WARNING

Be sure that power has been removed before disassembling the Generator.

Follow as much of the procedure as necessary to perform the degree of maintenance required.

Step 1. Unfasten the rear holdown screws.

Step 2. Remove the four phillips head screws located on the front panel and pull the Generator gently forward - until the Generator is free of the enclosure.

NOTE

The interior of the Generator is now available for general maintenance, troubleshooting, adjustment and cleaning purposes. When it is necessary to remove the shield covering the oscillator continue with the following steps exactly, exercising caution so that the capacitor plates are not bent.

Step 3. Mesh the tuning capacitor plates by rotating the tuning control fully counter-clockwise.

Step 4. Remove the shield mounting screws and slide the shield directly back until it stops against the high-level RF Amplifier shield on the rear panel.

Step 5. Lift the rear of the shield so that it rotates about its front edge and lift the shield gently away from its former mounting position.

Step 6. The balance of the Generator may be disassembled by conventional

means. All printed circuit boards are held in place with standard hardware and hard-wired. Exercise sufficient caution so that parts and assemblies are not damaged.

CAUTION

Do not disassemble the gear train. It requires no lubrication or maintenance.

5-9. PERFORMANCE CHECKS

5-10. The performance of the Generator may be checked by observing the operational condition of the three functional sections of the unit, frequency, modulation and amplitude. To check these functions follow the procedure of Table 5-3. The Generator should be energized and warmed up.

5-11. LOGICAL TROUBLESHOOTING PROCEDURE

5-12. Once the performance checks of Table 5-3 have been performed, and the malfunction

Table 5-1. List of Recommended Test Equipment

DESCRIPTION	MANUFACTURER	MODEL NO.
Counter	Monsanto	1020
Precision Digital Voltmeter	USC	400
Oscilloscope	Tektronix	585
Multimeter	Simpson Electric	260
RF Voltmeter	Hewlett-Packard	3406A
50 Ω Termination	Hewlett-Packard	0950-0090

Table 5-2. Power Supply Voltage Tolerances

SUPPLY VOLTAGE	LEVEL TOLERANCE	RIPPLE TOLERANCE
+12V	±2%	7mV
-12V	±5%	15mV
+28V	±5%	30mV
+5.2V	±5%	10mV
+3.6V	±5%	10mV
+170V	±10%	8 volts

Table 5-3. Performance Checks

FUNCTION	PROCEDURE	COMMENTS
1. Frequency	A. Set Generator for CW operation.	A. This step checks out step 3A below.
	B. Set the Range selector to the lowest band. Tune the generator throughout the band and observe the frequency readings on the digital display. Repeat this step for all bands. In addition, observe the amplitude meter for step 2A below.	B. At each band the frequency extremes should be greater than marked on the front panel. Also check operation of FINE control.
	C. To check the accuracy of the digital display connect a counter to the 50 ohm output connector and check the digital display against the counter. This step may be performed in conjunction with step 1A above.	C. Counter should have better resolution than digital display.
	D. To check the purity of the output signal frequency connect an oscilloscope or a spectrum analyzer to the 50 ohm output connector.	D. A good sinewave free of distortion should be seen on the oscilloscope. If a spectrum analyzer is used Harmonics shall be at least 30 db below the carrier at 1 Vrms max. Spurious AM at least 70 db below the carrier down to thermal noise threshold of 50 ohm system.
	E. Connect the RF voltmeter to the UNCAL RF connector.	E. The RF Voltmeter should read 100 mV nominal at all frequencies.
2. Amplitude	A. During step 1B above observe the amplitude meter.	There shall be no greater deviation of the meter needle greater than $\pm\frac{1}{2}$ db at any frequency setting.
	B. Adjust the level control from full CCW position to full CW position at any setting of the amplitude level switch.	B. The amplitude meter shall read from below 10% deflection past full scale reading.

Table 5-3. Performance Checks (Continued)

FUNCTION	PROCEDURE	COMMENTS
	C. Connect a precision RF voltmeter to the 50 ohm output connector. Starting at the lowest settings of the amplitude level control over its full range as in step 2B above. Repeat this step for every setting of the amplitude level switch.	C. The amplitude meter readings shall correspond with the RF voltmeter readings taking into account the tolerances of both meters.
3. Modulation	A. The CW OPERATIONAL capability was checked in step 1A above.	A. The CW sinewave output signal shall not be distorted.
	B. Connect a counter to the MOD IN/OUT connector and switch the modulation mode switch to INT 1 KHz and INT 400 Hz respectively. Connect an oscilloscope to the 50 ohm output connector and observe the signal.	B. The counter shall read 1 KHz and 400 Hz at the respective modulation mode switch settings Sync the signal on the oscilloscope and observe that the oscilloscope trace is a modulated signal of the proper frequency.
	C. At each switch position in step 3B, with output level 1 Vrms or lower vary the DEPTH control over its full range.	C. Observe the PERCENT MODULATION meter. It should read from 0 to 100 as the DEPTH control is varied.
	D. Inject an external modulation signal into the MOD IN/OUT connector. Set the Generator to a frequency capable of being modulated by the external signal frequency.	D. Observe the output signal at the 50 ohm output. It should show a signal modulated at the MOD IN frequency.

localized to a particular function, the troubleshooting procedure of Table 5-4. will aid the technician in determining which circuit is malfunctioning. The table is logically organized by block and diagram functions, of oscillator, digital and output sections. The troubleshooting chart assumes that the following conditions have been satisfied:

a. The proper ac input voltage is applied and the power switch is on.

b. The fuse has not blown.

c. The power supply is operating properly and all dc voltages are available and being furnished to the Generator circuits as required.

d. That all internal cabling and connectors are properly connected.

5-13. TEST ADJUSTMENT AND CALIBRATION

5-14. To test adjust, and calibrate the Generator refer to the applicable procedure(s) described in the following paragraphs.

Table 5-4. Logical Troubleshooting Procedure

SECTION	POSSIBLE FAULT	POSSIBLE TROUBLE
Oscillator circuits	RF frequency range Bands 1-5 operative but Band 6 inoperative.	CHECK: P.C. Assy 600, Stages Q606, Q607 or Q608 and associated components, Relay K601.
	RF frequency Band 6 operative but Bands 1-5 inoperative.	CHECK: P.C. Assy 600: Stages Q601, Q602, Q603, Relay K601
	RF frequency Band 6 operative but anyone of Bands 1-5 inoperative.	CHECK: Associated tuning coil and bandswitch contacts.
	All Bands operative but tuning and output amplitude is spotty.	CHECK: C605 main tuning capacitor for shorts and/or dirt between the plates.
	TUNING Control operative on all bands but FINE tuning control inoperative.	CHECK: Operation of R642 potentiometer and associated components on P.C. Assy 600.
	TUNING control satisfactory but FINE tuning control inoperative or malfunctioning on Bands 1-5 (Band 6 operative).	CHECK: Varicap diode CR601 and associated circuitry.
	Same as above but Bands 1-5 operative and Band 6 inoperative or malfunctioning.	CHECK: Varicap diode CR604, and associated circuitry.
	Uncalibrated RF output signal available but CW unmodulated signal not available at 50 ohm output connector. Digital display reads proper frequency.	CHECK: P.C. Assy 600, Stage Q605.
	Proper signal available at 50 ohm signal output connector but digital display and/or uncalibrated RF output readings improper.	CHECK: P.C. Assy 600, Stage Q604 and associated circuitry.
	All functions operating but TUNING range operation and/or control is inadequate.	CHECK: Bandswitch and gear train coupling action.

Table 5-4. Logical Troubleshooting Procedure (Continued)

SECTION	POSSIBLE FAULT	POSSIBLE TROUBLE
	Output signal levels on Bands 1-5 are not consistent for the same settings of all operating controls. Band 6 and the balance of Generator circuits operating properly.	CHECK: AGC circuit and associated components Q602, CR602, CR603 etc and setting of R250.
	Bands 1-5 and balance of Generator circuits operating properly but band 6 signal output level inconsistent with those of Bands 1-5 for the same settings of operating controls.	CHECK: AGC circuit and associated components Q607, CR605, CR606 and setting of R640.
Modulation Circuits	NOTE: The following procedure assumes that the Oscillator Section has been checked and is operating normally.	
	Generator does not modulate carrier in any mode; or percentage of modulation cannot be adjusted in any mode. Check operation of the LEVEL control in this step. Although this function is part of the amplitude section it is more easily checked here.	CHECK: P.C. Assy 600 operational amplifier A502 and associated components; CHECK DEPTH potentiometer R519. Check LEVEL potentiometer R521 and associated components.
	CW signal available at 50 ohm calibrated output connector but 400 Hz and/or 1 KHz internal signals do not modulate the carrier when the modulation mode switch is set to those respective positions.	CHECK: P.C. Assy 500, Wein-bridge oscillator A502, and associated components.
Amplitude	NOTE: The following procedures assume that the Oscillator and Modulation Circuits are operating properly.	
	Amplitude meter does not level from band to band with control settings unchanged.	CHECK: P.C. Assy 700, AGC output and detector stage including diode CR701 and associated components.

Table 5-4. Logical Troubleshooting Procedure (Continued)

SECTION	POSSIBLE FAULT	POSSIBLE TROUBLE
	Amplitude level meter indicates no or low output signal.	CHECK: P.C. Assy 700, Stages Q701, Q702, and associated components. Check meter if suspect.
	Modulation and amplitude circuits operate normally however, low or no output signal condition still exists at one or more setting of the precision attenuator.	CHECK: The precision attenuator.
Digital Section	NOTE: The following assumes that all functions of the Generator other than the Digital Section is operative, and that the nixie ® tubes are in good condition.	
	Digital Counter display is correct above 10 MHz but not below 10 MHz.	CHECK: P.C. Assy 100, Stages Q101 through Q104; and A103, and associated components.
	Digital Counter display is correct below 10 MHz but not above 10 MHz.	CHECK: P.C. Assy 300, Stages Q303, Q304, A320 and associated components.
	Digital Counter display is improper on all ranges. Check 1 MHz crystal clock oscillator first. If the crystal oscillator circuit is operative check the balance of P.C. assembly 300.	Check 1 MHz oscillator circuit Q301 and associated circuits. If operative check balance of P.C. Assys 300 and PC200.

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NOTE

Before making any adjustments check that the Generator controls were set as desired and that no mistake was made in interpreting the meter readings versus the control settings. In addition check the operation of the power supply and be sure that the Generator is set to operate from the available ac power source (115/230 vac).

5-15. POWER SUPPLY ADJUSTMENT

5-16. The power supply (P.C. Assembly 800) should be checked before making any adjustments to the Generator. If the power supply is not operating properly false conclusions may be drawn and unnecessary adjustments made with a resultant waste of time. The power supply assembly is located on the underside of the chassis as shown in Figure 6-2. To check and adjust the power supply so that it is operating properly proceed as follows.

Step 1. Check that the ac input line voltage is at the proper level.

Step 2. Remove the Generator from its enclosure as described in paragraph 5-7.

Step 3. Connect a precision voltmeter to the positive side of C807. The voltmeter should read +12 vdc ±2%. If it does not, adjust R811 until it does. Measure the ripple with an oscilloscope. It should not exceed 7 mV pp.

Step 4. Check the other power supply output voltages for dc level and ripple as shown in Table 5-2. The readings should be within the tolerances shown.

5-17. MAIN OSCILLATORS LEVEL SET

5-18. To check and/or adjust the Generator HF and VHF Oscillators, use the following procedure. Refer to the test setup of Figure 5-1.

Step 1. Disconnect main oscillator output BNC.

Step 2. Connect main oscillator output to 50 OHM termination and H.P. 3406A as shown in test setup of Figure 5-1.

Step 3. Set 920A frequency to low end of Band 5 (10 MHz).

Step 4. The H.P. 3406A should indicate 50 millivolts rms. If it doesn't adjust R645 until it does.

Step 5. Set 920A frequency to high end of Band 5 (32 MHz).

Step 6. Oscillator output level shall be 50 millivolts ±1 db.

Step 7. Set 920A frequency to low end of Band 6 (32 MHz).

Step 8. The H.P. 3406A should indicate a 50 millivolts rms reading. If it doesn't adjust R646 until it does.

Step 9. Set 920A frequency to high end of Band 7 (80 MHz).

Step 10. Oscillator output level shall be 50 millivolts ±1 db.

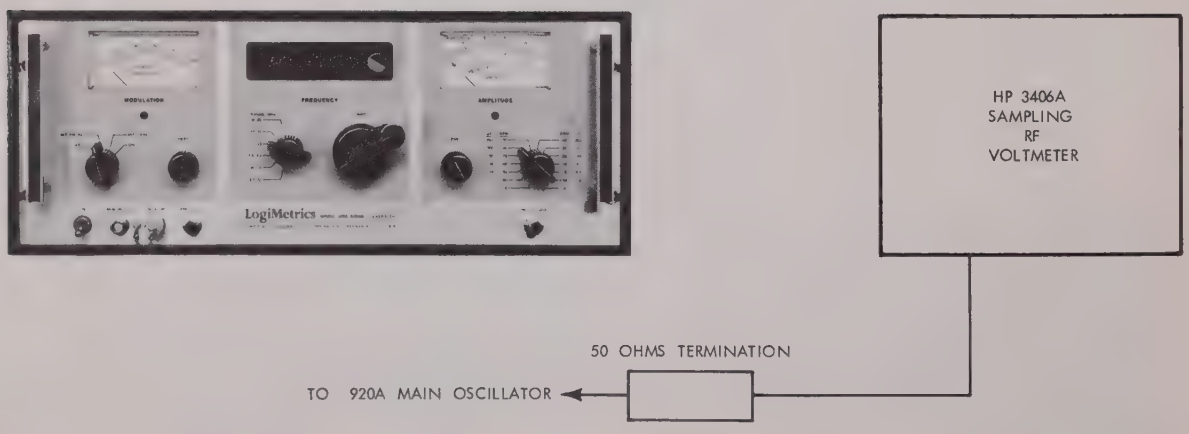


Figure 5-1. Oscillator Level Set, Test Setup

Step 11. Remove test equipment and reconnect 920A cable to oscillator output BNC connector.

5-19. METER LEVEL CALIBRATION

5-20. To check and adjust the Generator meter level calibration use the following procedure. Refer to the test setup of Figure 5-2.

Step 1. Set 920A to low end of Band 5 (10 MHz).

Step 2. Set output attenuator to 1 volt.

Step 3. Connect H.P. 3406A, and 50 OHM termination to 50 Ω output of 920A.

Step 4. Turn front panel LEVEL control until 1 volt is read on H.P. 3406A.

Step 5. If 920A output AMPLITUDE meter does not read 1 volt rms adjust 1 volt meter calibration potentiometer R1008 until it does.

Step 6. Set H.P. 3406A to 3 volt scale, and 920A output attenuator to 3 volt rms.

Step 7. If the H.P. 3406A does not read 3.18 volts, adjust 3 volt R.F. set potentiometer R1010 until it does.

Step 8. If 920A output AMPLITUDE meter does not read 3.18 volts rms adjust 3 volt meter calibration potentiometer R1009 until it does.

5-21. MODULATION CALIBRATION

5-22. To check and/or adjust the Generator Modulation meter circuits, use the following procedure. Refer to the test setup of Figure 5-3.

Step 1. Set 920A modulation mode selector to INT 1 KHz.

Step 2. Turn modulation DEPTH control to maximum CCW position.

Step 3. Connect the Oscilloscope probe to output side of R512, i.e. Junction of R515 and R019.

Step 4. A 10 volt peak to peak sinewave should be seen on the oscilloscope. If not, adjust R510 to obtain a 10 volt peak to peak reading.

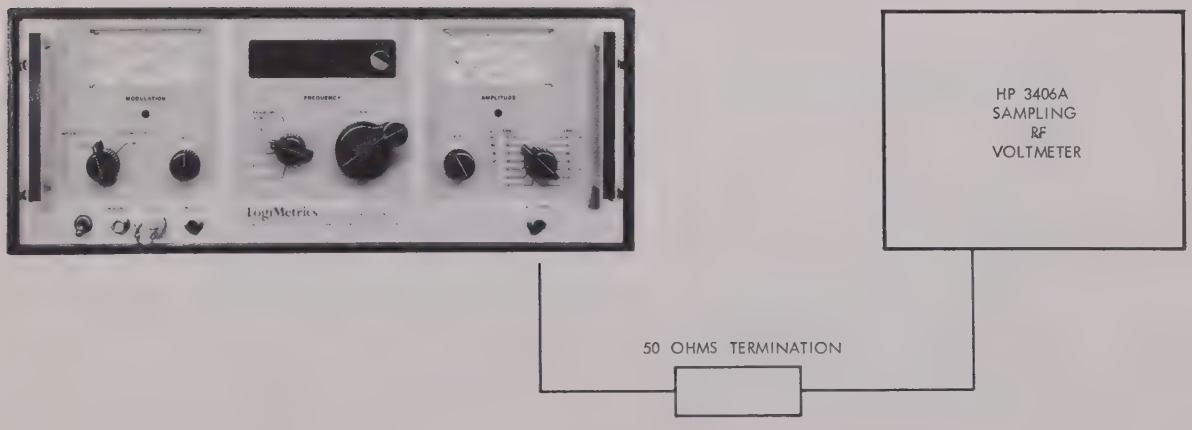


Figure 5-2. Meter Level Calibration, Test Setup

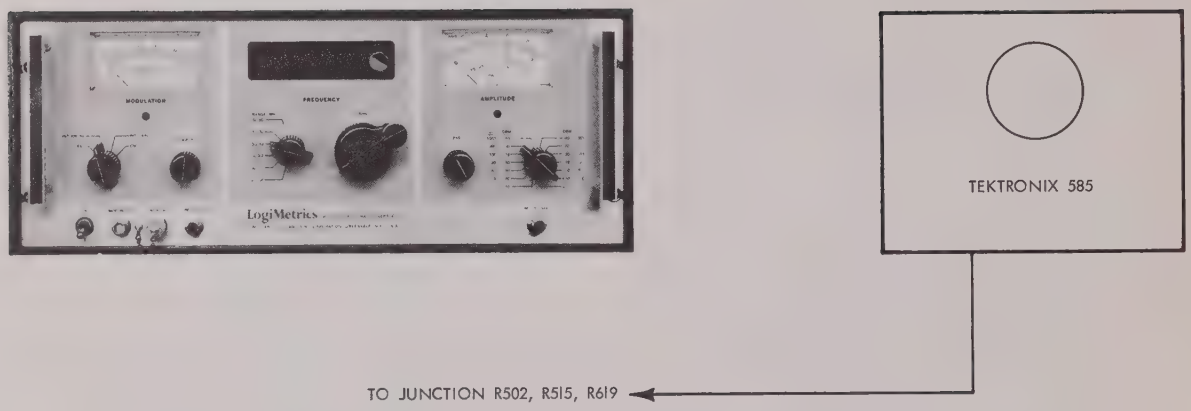


Figure 5-3. Modulation Calibration, Test Setup

Step 5. Set the modulation selector switch to INT 400 Hz. Oscilloscope level should remain at 10 volts peak to peak.

Step 6. Set frequency of 920A to low end of Band 4 (3.2 MHz).

Step 7. Set output signal of 920A to 1 volt rms.

Step 8. Set Modulation mode selector switch to INT 1 KHz.

Step 9. Observe 920A output signal on oscilloscope.

Step 10. Rotate 920A Modulation DEPTH until the oscilloscope pattern exhibits a peak to valley ratio of 6:1. This is accomplished by simultaneously adjusting the 920A Modulation DEPTH Control and the Scope Variable Gain Control so that the maximum envelope excursion remains at 6 cm peak to peak.

Step 11. The 920A front panel modulation DEPTH meter should indicate 72%. If it doesn't adjust mod. meter cal. potentiometer R520 until it does.

Step 12. Repeat steps 9 and 10 if necessary.

Step 13. Set the output of the 920A to 0.3 volts rms.

Step 14. Set the 920A front panel modulation DEPTH Control to 72% on 920A PERCENTAGE MODULATION Meter.

Step 15. The scope pattern should exhibit a peak to valley ratio of 6:1. If it doesn't adjust modulation tracking potentiometer R517 until it does.

Step 16. Set Modulation Selector Switch to EXT.

Step 17. Inject a 3 volt, 1 KHz audio signal into MOD IN/OUT front panel BNC Connector.

Step 18. Turn DEPTH/control full CW.

Step 19. Check that the 920A PERCENTAGE MODULATION Meter reads full scale or above.

5-23. INTERNAL MODULATION FREQUENCY CHECK

5-24. To check the Generator internal modulation frequencies for accuracy use the following procedure. Refer to the test setup of Figure 5-4.

Step 1. Connect the counter to MOD IN/OUT front panel BNC connector.

Step 2. Turn modulation mode selector to INT 1 KHz.

Step 3. Counter frequency shall be 1 KHz ±5% max.

Step 4. Turn modulation mode selector to INT 400 Hz.

Step 5. Counter frequency shall be 400 Hz, ±5% max.

5-25. 1 MHz CLOCK OSCILLATOR CHECK

5-26. To check and/or adjust the Generator digital display 1 MHz crystal oscillator reference clock use the following procedure. Refer to the test setup of Figure 5-5.

Step 1. Disassemble the Generator as described in paragraph 5-7.

Step 2. Connect a counter, using a high impedance, low capacitance probe to the junction of Q302 and R303 on P.C. Assembly 300. This is the large P/C board mounted vertically above the chassis as shown in Figure 6-1.

Step 3. Set the counter timebase to 1 second.

Step 4. Adjust trimmer capacitor C303 using an insulated alignment tool to obtain exactly 1 MHz from the crystal oscillator as read on the counter (1.000,000 Hz ±5 Hz).

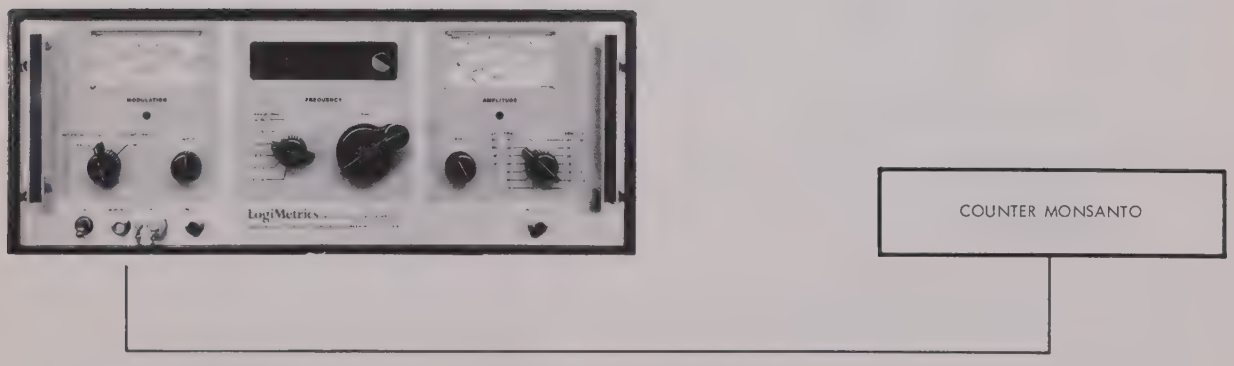


Figure 5-4. Internal Modulation Frequency Accuracy, Test Setup

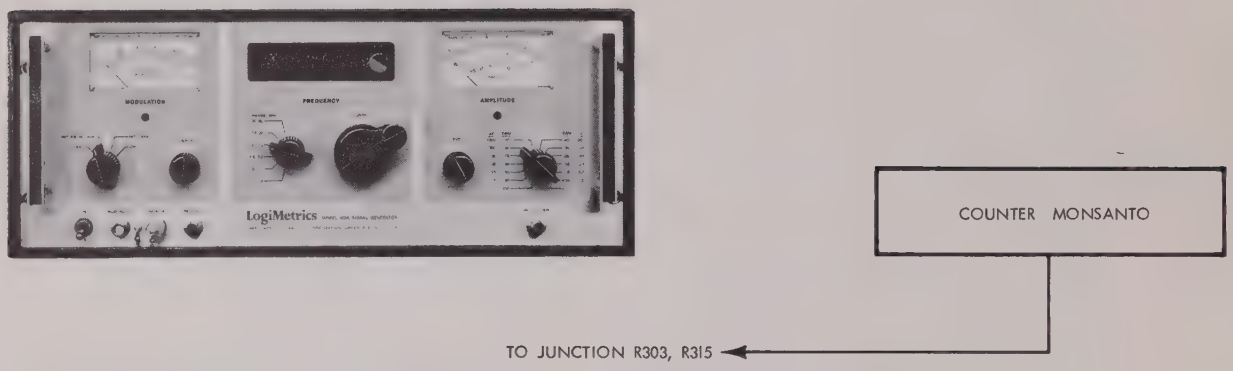


Figure 5-5. Digital Display 1 MHz Oscillator Check Test Setup

5-27. ENVELOPE LINEARITY CHECK

5-28. To check the Generator's output signal envelope linearity use the following procedure. Refer to the test setup of Figure 5-6.

Step 1. Set the 920A Bandswitch to Band 5.

Step 2. Set 920A Modulation mode selector switch to CW.

Step 3. Set the 920A frequency to 32 MHz.

Step 4. Set the 920A AMPLITUDE Attenuator switch to 0.003 volts.

Step 5. Adjust the 920A LEVEL control so that the output AMPLITUDE meter indicates full scale.

Step 6. Connect the 920A 50 Ω output to the Kay Attenuator Pad.

Step 7. Connect the other end of the Kay Pad to the Spectrum Analyzer and set the Spectrum Analyzer to Log Response.

Step 8. Set Spectrum Analyzer Bandwidth to 10 KHz.

Step 9. Set Sweep Speed to 0.2 sec./cm.

Step 10. Set Spectrum Analyzer so that the image appears on screen.

Step 11. Adjust Kay Pad so that image is exactly full screen.

Step 12. Decrease 920A Attenuator to -70 DBM.

Step 13. Mark a horizontal line on Analyzer Screen. Label line -30 DB.

Step 14. Decrease 920A Attenuator to -80 DBM.

Step 15. Mark a horizontal line on Analyzer Screen. Label line -40 DB.

Step 16. Reset 920A attenuator to -40 DB. Check that image is again full screen.

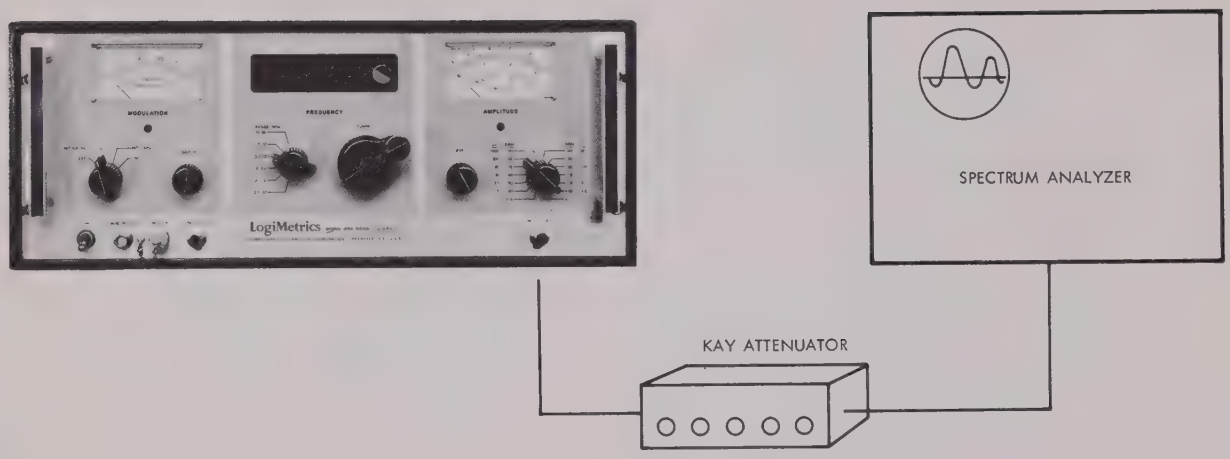


Figure 5-6. Envelope Linearity - CW Distortion, Test Setup

Step 17. Turn 920A modulation mode selector switch to INT 1 KHz.

Step 18. Set 920A Modulation Depth to 30%.

Step 19. Adjust Kay Pad so that primary side bands are full screen.

Step 20. Second order sideband shall be -40 DB down minimum from primary side band as seen on the analyzer screen.

Step 21. Adjust 920A Mod. Depth to 70%.

Step 22. Adjust Kay Pad so that primary sidebands are full scale.

Step 23. Second order sidebands shall be -30 DB down minimum from primary sidebands as seen on the analyzer screen.

5-29. CW DISTORTION CHECK

5-30. To check the CW distortion characteristics of the Generator, use the following procedure. Refer to the test setup of Figure 5-6.

Step 1. Same first steps as Step 1 to Step 16 of paragraph 5-27.

Step 2. Tune the Analyzer to second harmonic and obtain an image on the Analyzer.

Step 3. Note the level of image relative to 30 DB line on analyzer screen. It must be greater than -30 DB down.

Step 4. Set the 920A Bandswitch to Band 6.

Step 5. Set frequency to 32.00. The harmonic will appear on analyzer screen.

Step 6. Note level of image relative to 30 DB line on analyzer screen. It must be greater than -30 DB down.

5-31. ATTENUATOR CHECK

5-32. To check the accuracy of Generator's precision attenuator, use the following procedure. Refer to the test setup of Figure 5-7.

Step 1. Set the 920A frequency to 10 MHz.

Step 2. Set the 920A output attenuator to +13 DBM.

Step 3. Set the 920A modulation mode selector switch to INT 400 Hz.

Step 4. Set the 920A Modulation Depth to 70%.

Step 5. Set the 920A output level to 1 volt rms.

Step 6. Connect the 920A through the Kay Attenuator Pad to the Receiver.

Step 7. Connect the Simpson multimeter across the speaker terminals. Use the A.C. scale.

Step 8. Set the Kay Pad to 120 DB of attenuation.

Step 9. Tune in the Receiver.

Step 10. Note the reading on Simpson.

Step 11. Increasing the 920A Attenuation and decreasing the Kay Pad Attenuation by equal amounts should yield a constant reading on the Simpson.

Step 12. Check each step of the 920A output Attenuator by turning the pad C.C.W. Record Data.

Step 13. Turn 920A Level Control Full C.C.W. No sound should be heard from the Receiver.

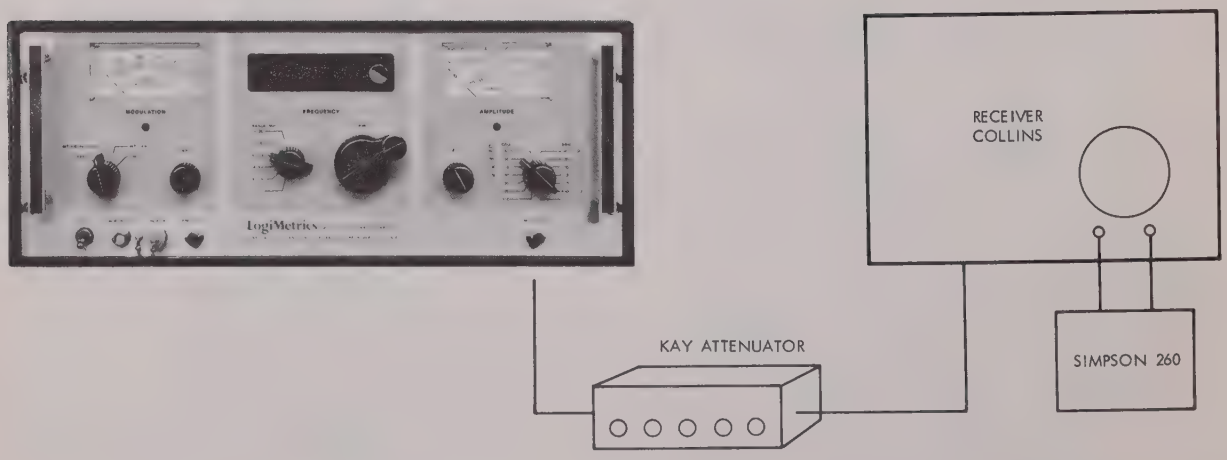


Figure 5-7. Attenuator Check, Test Setup

SECTION VI
ILLUSTRATED PARTS LIST
CIRCUIT DIAGRAMS

6-1. GENERAL

6-2. This section contains schematic diagrams, parts lists and parts location diagrams. All parts location diagrams are located adjacent to their respective parts lists.

6-3. PARTS LISTS

6-4. Each parts list contains a listing of parts by reference symbol number. Each commercial part is identified by the manufacturer's part number, its value or rating, a description of the part, and the manufacturer's name. Military part numbers such as the RC type resistors are not identified by manufacturer in most cases.

6-5. PARTS LOCATION DIAGRAM

6-6. Photographs are included as an aid in the physical location of a component. Each component is identified by its reference symbol number.

6-7. SCHEMATIC DIAGRAMS

6-8. The schematic diagrams are also contained in this section. They illustrate the electrical circuit diagram connections for all P.C. boards as well as the overall system connections. All parts are identified by reference symbol number designation and component ratings as applicable.

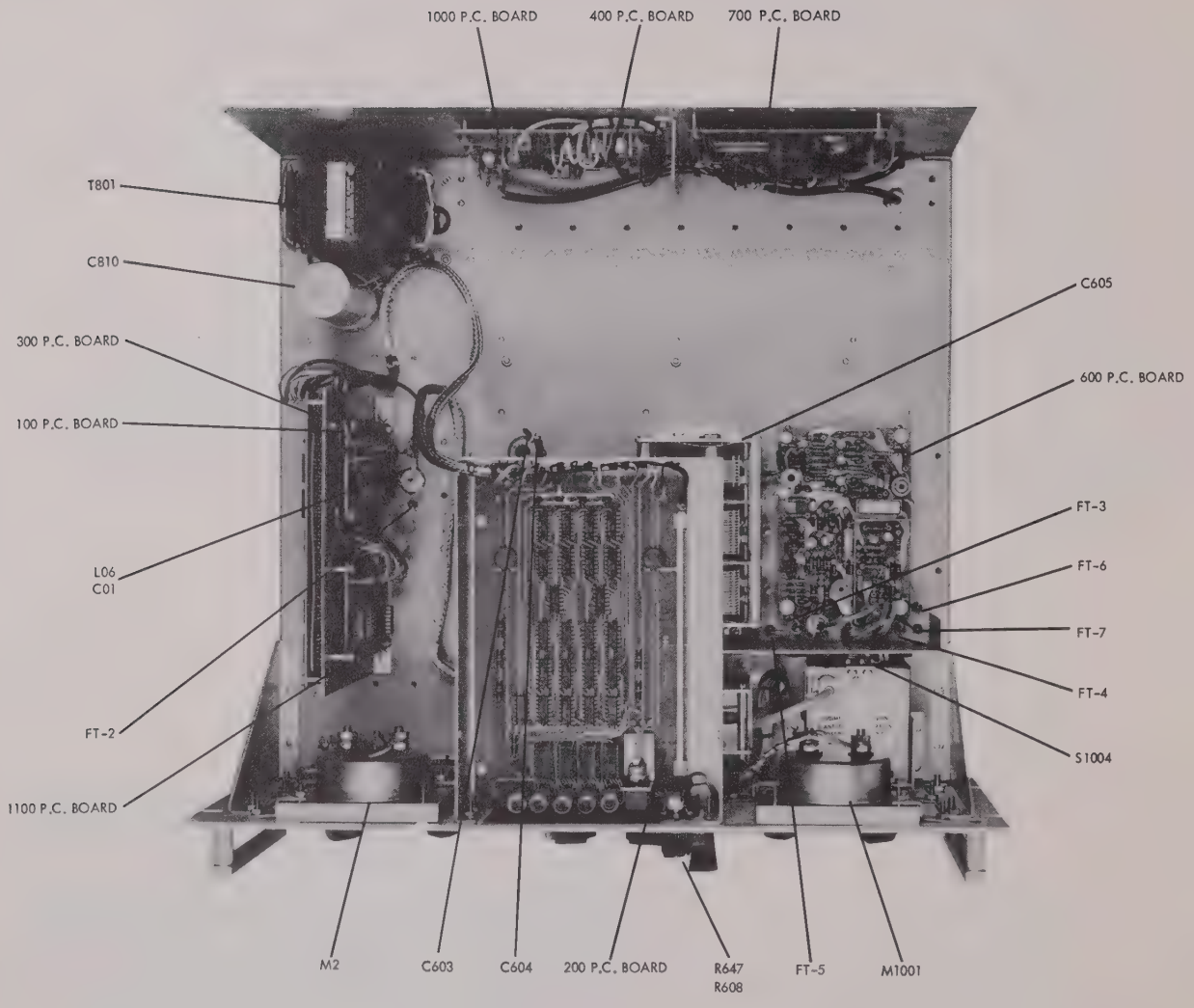


Figure 6-1. Chassis-Mounted, Top View Parts Location

Circuit Designation	Description	Part No.	Manufacturer
C01	Capacitor, 25 uf/25v Electrolytic	30D-TE-1207	Sprague
C603	Capacitor, 10 pf, ±5% Mica	DM15-100J	CD
C604	Capacitor, 15 pf, ±5% Mica	DM15-150J	CD
C605	Capacitor, Variable	C10-061C	
C810	Capacitor, 9200 uf/15v Electrolytic	36D-.2A-922G015AB	Sprague
FT-2	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-3	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-4	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-5	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-6	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-7	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
L06	Coil, RF	2307-561	Delevan
M2	Meter, Modulation	A10-079	Logimetrics
M1001	Meter, RF Level	A10-080	Logimetrics
R608	Resistor, Carbon, 10K, ±5% $\frac{1}{2}$w	RC20GF103J	
R647	Resistor, Potentiometer, 10K, 2w	CU1031	Ohmite
S1004			
T802	Transformer, Power	C10-047A	Logimetrics
100	P.C. Assembly		Logimetrics
200	P.C. Assembly		Logimetrics
300	P.C. Assembly		Logimetrics
400	P.C. Assembly		Logimetrics
600	P.C. Assembly		Logimetrics
700	P.C. Assembly		Logimetrics
1000	P.C. Assembly		Logimetrics
1100	P.C. Assembly		Logimetrics

Figure 6-1. Chassis - Mounted, Top View Parts List

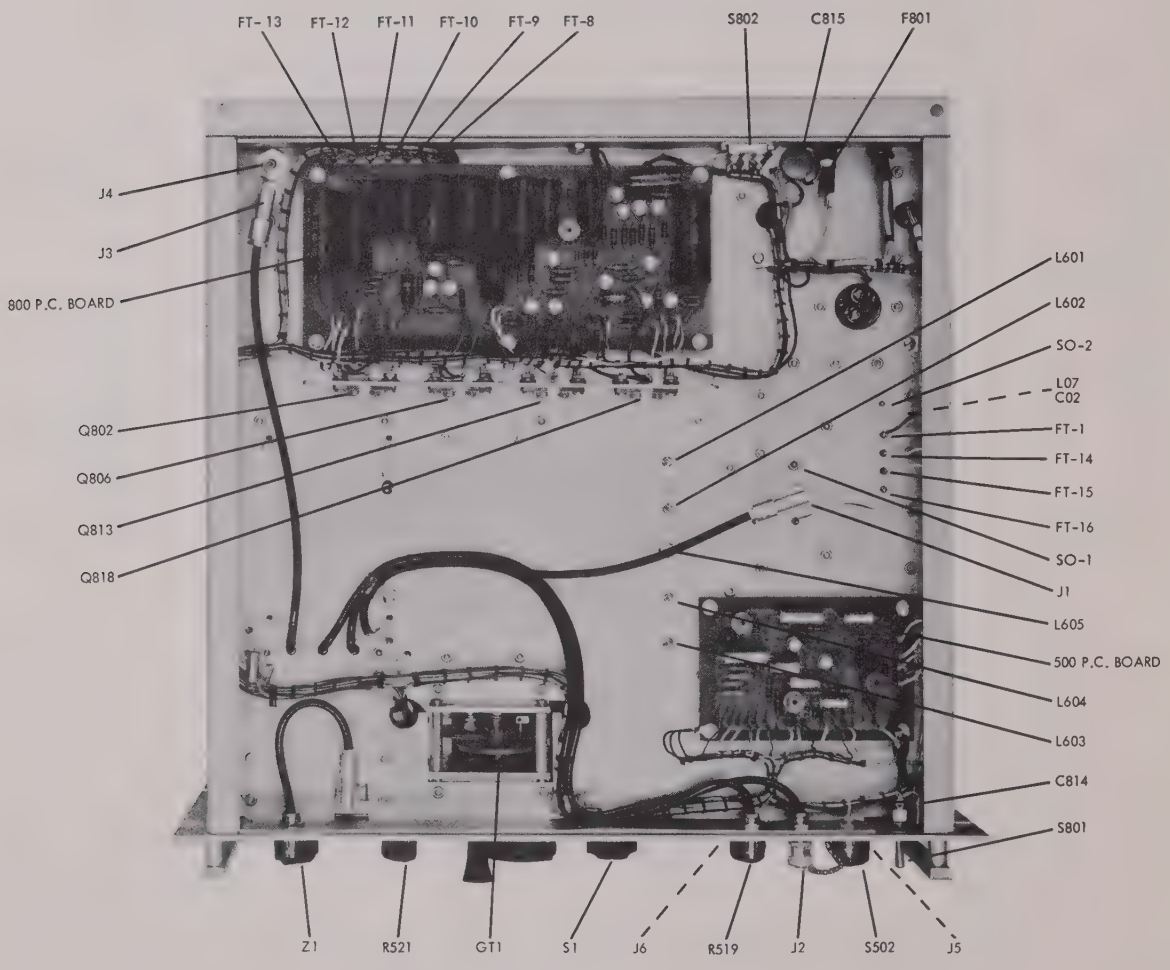


Figure 6-2. Chassis-Mounted, Bottom View Parts Location

Circuit Designation	Description	Part No.	Manufacturer
C02	Capacitor, .02 uf/25v	5835-000.45u-203Z	Erie
C814	Capacitor, .01 uf/1.4kv	CI-103	Centralab
C815	Capacitor, .01 uf/1.4kv	CI-103	Centralab
F801	Fuse, $\frac{1}{2}$ Amp/230v	3AG$\frac{1}{2}$A S.B.	Littlefuse
FT-1	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-8	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-9	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-10	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-11	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-12	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-13	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-14	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-15	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
FT-16	Capacitor, Feed Thru, 1500 pf	2499-003-X5SO-152M	Erie
GT1	Gear Train 56.25:1	5160G-1	Jackson Bros.
J1	Connector, Female		
J2	Connector, Female		
J3	Connector, Female		
J4	Connector, Female		
J5	Connector, Female		
J6	Connector, Female		
L07	Coil, RF	2307-271	Delevan
L601	Coil	10986	North Hills
L602	Coil	10829	North Hills
L603	Coil	10831	North Hills
L604	Coil	1300I	North Hills
L605	Coil	1300D	North Hills
Q802	Transistor, Silicon NPN	2N3055	Motorola
Q806	Transistor, Silicon NPN	2N3055	Motorola
Q813	Transistor, Silicon NPN	2N3055	Motorola
Q818	Transistor, Silicon NPN	2N3055	Motorola
R519	Resistor, Potentiometer, 5K, 2w	CU5021	Ohmite
R521	Resistor, Potentiometer, 1K, 2w	CU1021	Ohmite
S1	Switch		
S502	Switch		
S801	Switch, Toggle SPST	8868K7	Cutler-Hammer
S802	Switch, Slide DPDT	46206LF	Switchcraft
S0-1	Terminal, Standoff		
S0-2	Terminal, Standoff		
Z1	Attenuator	Model 464TE	Kay
500	P.C. Assembly		
800	P.C. Assembly		

Figure 6-2. Chassis-Mounted, Bottom View Parts List

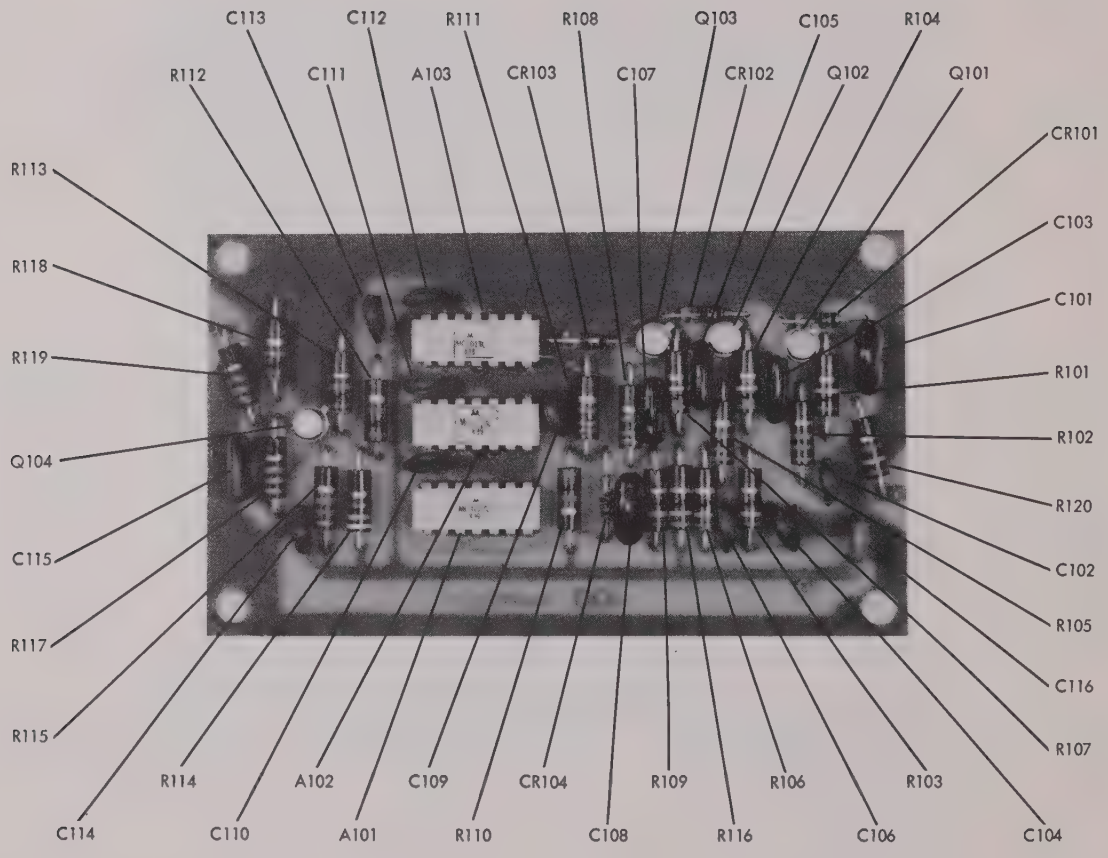


Figure 6-3. Prescaler Circuits (P.C. Assembly 100) Parts Location

Circuit Designation	Description	Part No.	Manufacturer
A101	Integrated Circuit	MC1027L	Motorola
A102	Integrated Circuit	MC1013L	Motorola
A103	Integrated Circuit	MC1013L	Motorola
C101	Capacitor, 470 pf, 5% Mica	DM15-471J	Elmenco
C102	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C103	Capacitor, 100 pf, 5% Mica	DM15-101J	Elmenco
C104	Capacitor, .02uf/25v Ceramic	Y5U-203Z	Erie
C105	Capacitor, 100 pf, 5% Mica	DM15-101J	Elmenco
C106	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C107	Capacitor, 20 pf Mica	DM15-101J	Elmenco
C108	Capacitor, 470 pf, 5% Mica	DM15-471J	Elmenco
C109-114	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C115	Capacitor, 15 pf, 5% Mica	DM15-150J	Erie
C116	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
CR101-104	Diode	1N914	Motorola
Q101-103	Transistor	2N709	RCA
Q104	Transistor	2N706	RCA
R101	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF103J	
R102	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R103	Resistor, Carbon, 27 ±5%, $\frac{1}{2}$w	RC20GF270J	
R104	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF103J	
R105	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R106	Resistor, Carbon, 27 ±5%, $\frac{1}{2}$w	RC20GF270J	
R107	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF103J	
R108	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R109	Resistor, Carbon, 68 ±5%, $\frac{1}{2}$w	RC20GF680J	
R110	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R111	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R112	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R113	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R114	Resistor, Carbon, 4.7K ±5%, $\frac{1}{2}$w	RC20GF472J	
R115	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R116	Resistor, Carbon, 27 ±5%, $\frac{1}{2}$w	RC20GF270J	
R117	Resistor, Carbon, 2.2K ±5%, $\frac{1}{2}$w	RC20GF222J	
R118	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R119	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R120	Resistor, Carbon, 180 ±5%, $\frac{1}{2}$w	RC20GF181J	

Figure 6-3. Prescaler Circuits (P.C. Assembly 100) Parts List

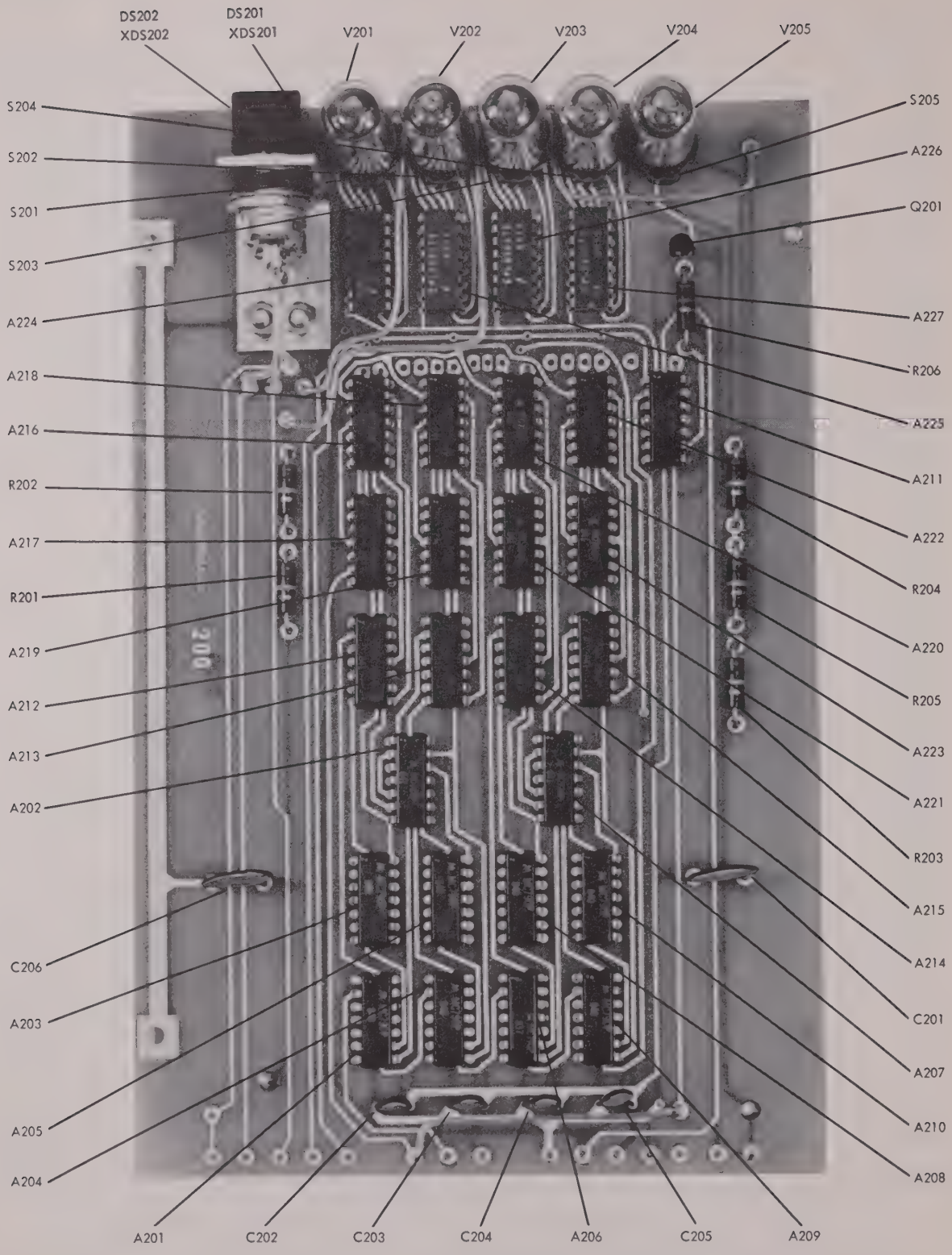


Figure 6-4. Counter, Storage, and Display Circuits (P.C. Assembly 200) Parts Location

Circuit Designation	Description	Part No.	Manufacturer
A201	Integrated Circuit	MC890P	Motorola
A202	Integrated Circuit	MC824P	Motorola
A203-206	Integrated Circuit	MC890P	Motorola
A207	Integrated Circuit	MC824P	Motorola
A208-211	Integrated Circuit	MC890P	Motorola
A212-223	Integrated Circuit	MC824P	Motorola
A224-227	Integrated Circuit	U6B996079X	Fairchild
C201	Capacitor, .02 uf/500v	811-Z5U-203M	Erie
C202-205	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C206-209	Capacitor, .02 uf/500v	811-Z5U-203M	Erie
DS201,202	Lamp, Glow	27730	Signalite
Q201	Transistor	2N4410	Motorola
R201-204	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF103J	
R205	Resistor, Carbon, 39K ±5%, $\frac{1}{2}$w	RC20GF683J	
R206	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R207	Resistor, Carbon, 68K ±5%, $\frac{1}{2}$w	RC20GF683J	
S201-205	Socket, 16-Pin	K-016ST-7520	T.I.
V201-205	Indicator, Nixie	B5750	Burroughs
XDS201	Lamp Holder	B10-115	Dialco
XDS202	Lamp Holder	B10-116	Dialco

Figure 6-4. Counter, Storage, and Display Circuits (P.C. Assembly 200) Parts List

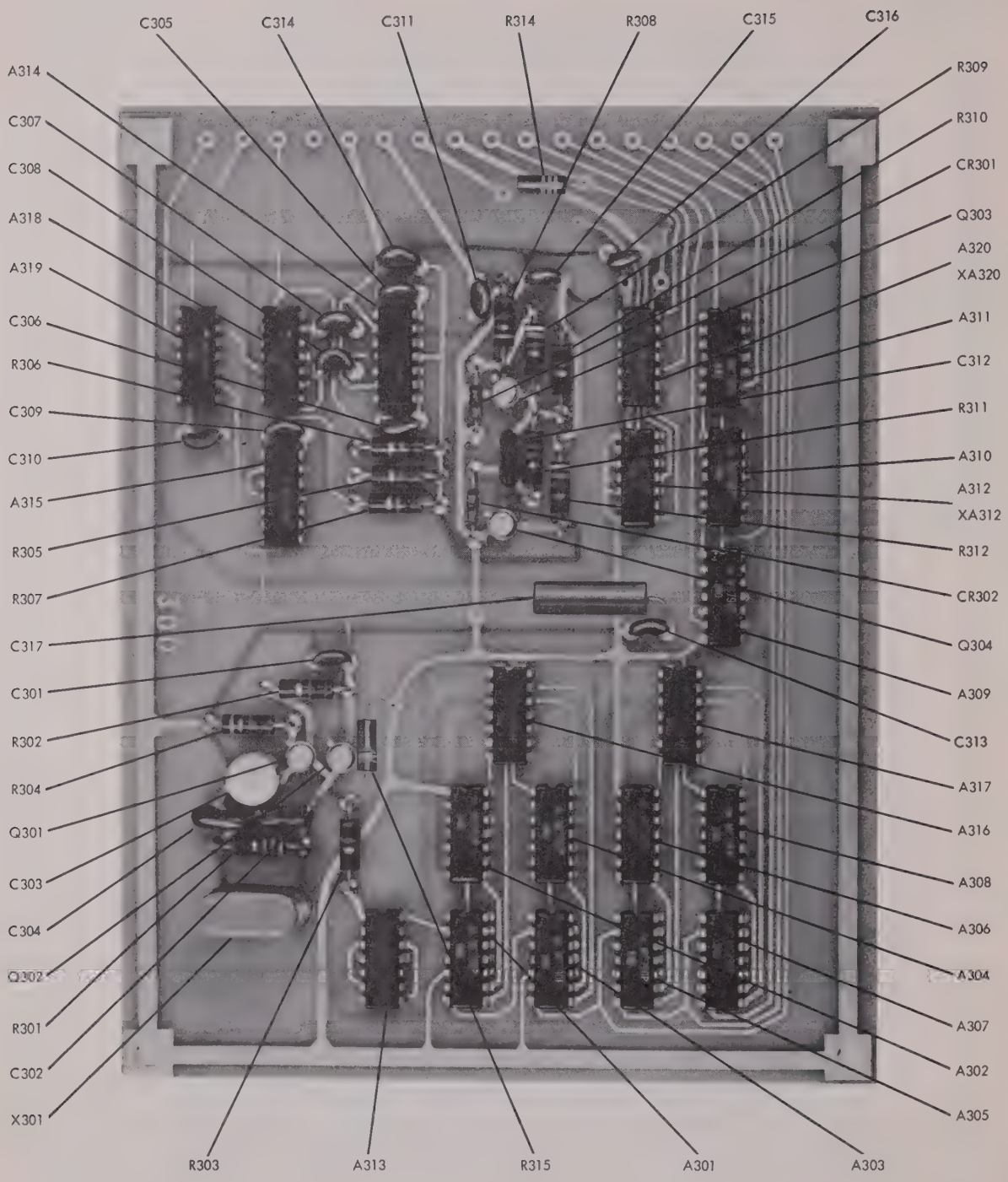


Figure 6-5. Gate Time Logic Circuits (P.C. Assembly 300)
Parts Location

Circuit Designation	Description	Part No.	Manufacturer
A301-312	Integrated Circuit	MC890	Motorola
A313-317	Integrated Circuit	MC824	Motorola
A318,319	Integrated Circuit	MC890	Motorola
A320	Integrated Circuit	MC824	Motorola
C301	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C302	Capacitor, 470 pf Mica	DM15-471J	Elmenco
C303	Capacitor, Variable 3-15 pf	538-011-315D	Erie
C304	Capacitor, 27 pf Mica	DM15-270J	Elmenco
C305-311	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C312	Capacitor, 100 pf Mica	DM15-101J	Elmenco
C313-315	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C316	Capacitor, 25 uf/25v Electrolytic	30D-TE-1207	Erie
C317	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
CR301	Diode	1N914	Motorola
CR302	Diode	1N914	Motorola
Q301	Transistor	2N4124	Motorola
Q302-304	Transistor	2N706	RCA
R301	Resistor, Carbon, 47K ±5%, $\frac{1}{2}$w	RC20GF473J	
R302,303	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R304	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R305-307	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R308	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R309	Resistor, Carbon, 4.7K ±5%, $\frac{1}{2}$w	RC20GF472J	
R310	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R311	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R312	Resistor, Carbon, 470 ±5%, $\frac{1}{2}$w	RC20GF471J	
R313	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R314	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R315	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
X301	Crystal, 1 MHz		Hunt
XA312,320	Sockets, IC	IC014ST-7519	T.I.

Figure 6-5. Gate Time Logic Circuits (P.C. Assembly 300) Parts List

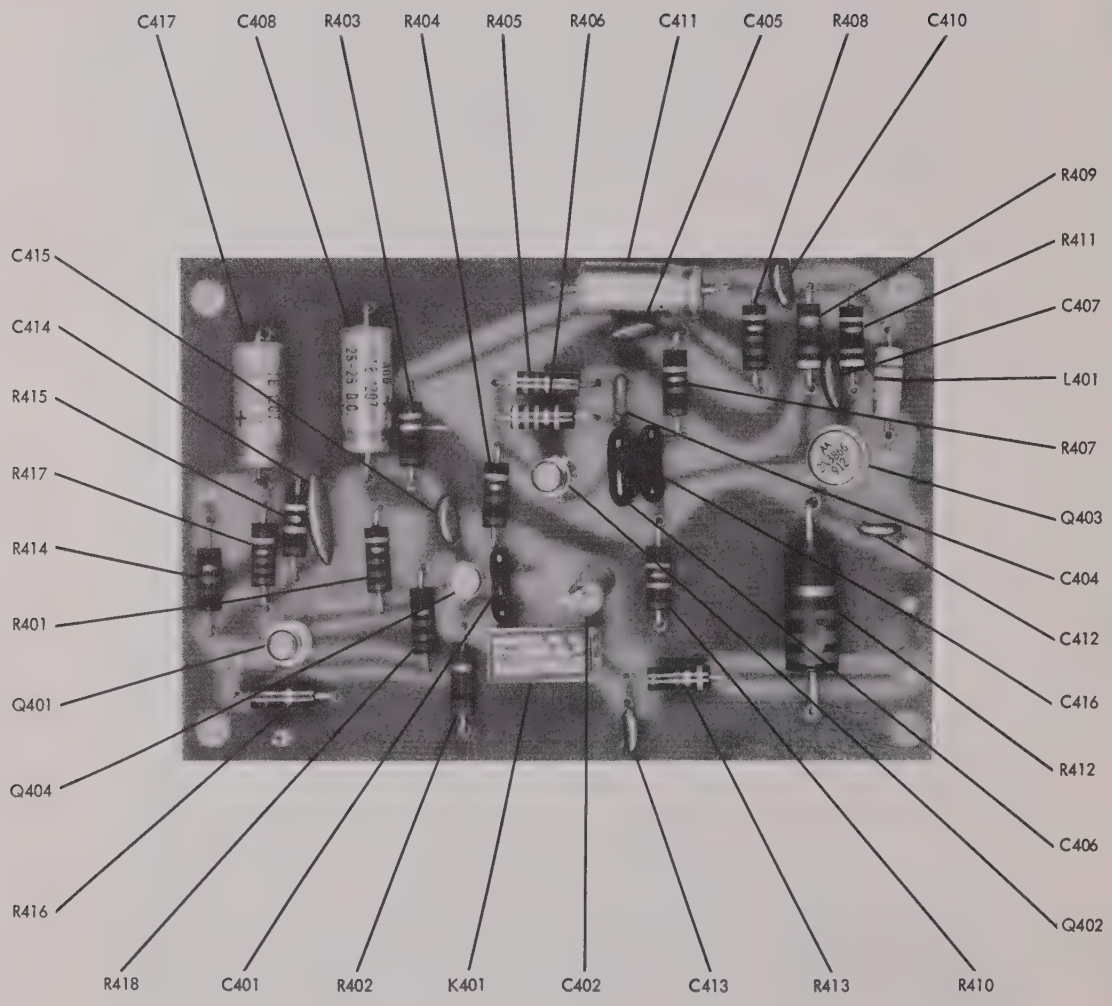


Figure 6-6. Modulation Circuits (P.C. Assembly 400A)
Parts Location

Circuit Designation	Description	Part No.	Manufacturer
C401	Capacitor, 1000 pf ±5% Mica	DM15-102J	CD
C402	Capacitor, .015 uf/200v Paper	192P15392	Sprague
C403	Not Used		
C404	Capacitor, .1 uf/100v ±20%	8131-100-651-104M	Erie
C405	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C406	Capacitor, 1000 pf ±5 Mica	DM15-102J	CD
C407	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C408	Capacitor, 25 uf/25v Electrolytic	30D-TE-1207	Sprague
C409	Not Used		
C410	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C411	Capacitor, 25 uf/25v Electrolytic	30D-TE-1207	Sprague
C412,413	Capacitor, .1 uf/100v ±20%	8131-100-651-104M	Erie
C414	Capacitor, 3300 pf ±10%	CF332	Centralab
C415	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C416	Capacitor, 1000 pf ±5% Mica	DM15-1027	CD
C417	Capacitor, 25 uf/25v Electrolytic	30D-TE-1027	Sprague
K401	Relay	W105MCPX-3	Magnecraft
L401	Inductor 100 uh ±10%	2307-104	Delevan
Q401	Transistor (FET)	MFE3007	Motorola
Q402	Transistor	2N2857	RCA
Q403	Transistor	2N3866	Motorola
R401	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R402	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF102J	
R403	Resistor, Carbon, 10 ±5%, $\frac{1}{2}$w	RC20GF100J	
R404	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R405	Resistor, Carbon, 470 ±5%, $\frac{1}{2}$w	RC20GF471J	
R406	Resistor, Carbon, 47K ±5%, $\frac{1}{2}$w	RC20GF473J	
R407	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
R408	Resistor, Carbon, 220 ±5%, $\frac{1}{2}$w	RC20GF221J	
R409	Resistor, Carbon, 4.7K ±5%, $\frac{1}{2}$w	RC20GF472J	
R410	Resistor, Carbon, 15K ±5%, $\frac{1}{2}$w	RC20GF153J	
R411	Resistor, Carbon, 47 ±5%, $\frac{1}{2}$w	RC20GF470J	
R412	Resistor, Carbon, 220 ±5%, 2w	RC42GF221J	
R413	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R414	Resistor, Carbon, 5.6K ±5%, $\frac{1}{2}$w	RC20GF562J	
R415	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF103J	
R416	Resistor, Carbon, 56 ±5%, $\frac{1}{2}$w	RC20GF560J	
R417	Resistor, Carbon, 2.2K ±5%, $\frac{1}{2}$w	RC20GF222J	
R418	Resistor, Carbon, 1.2K ±5%, $\frac{1}{2}$w	RC20GF122J	
XQ401	Socket, FET	8060-164	Augat

Figure 6-6. Modulation Circuits (P.C. Assembly 400A)
Parts List

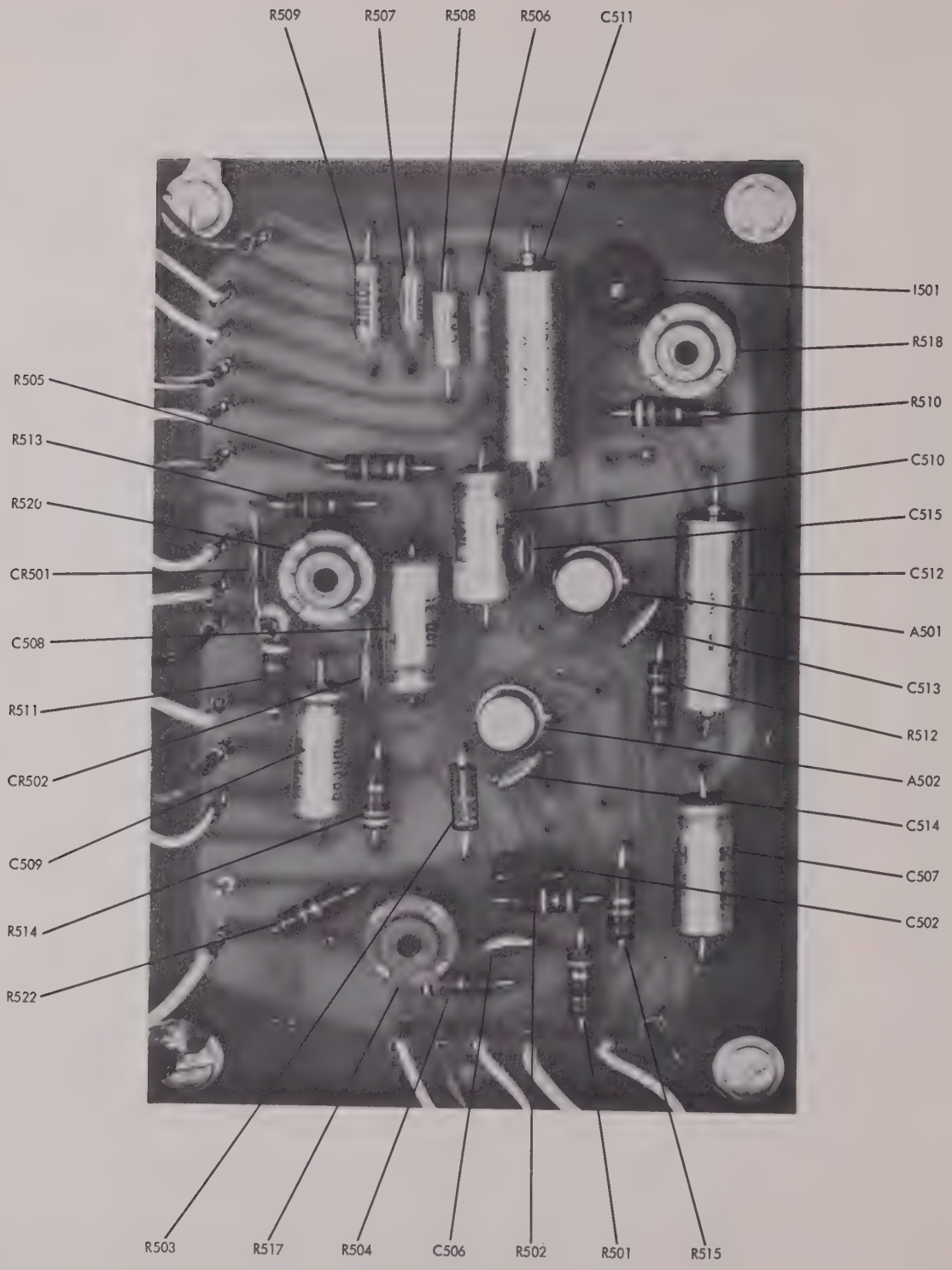


Figure 6-7. Audio and Level Control Circuits (P.C. Assembly 500A) Parts Location

Circuit Designation	Description	Part No.	Manufacturer
A501,502	Integrated Circuit	WA741	Fairchild
C501	Not Used		
C502	Capacitor, 470 pf/500v Mica	DM15-471J	CD
C503-505	Not Used		
C506	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C507-510	Capacitor, 25 uf/25v Electrolytic	30D-TE-1207	Sprague
C511,512	Capacitor, .1 uf/100v ±1% P'styrene	S10002D0A	DEL
C513,514	Capacitor, .01 uf/50v Ceramic	CK103	Centralab
C515	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
CR501,502	Diode	1N82AG	Sylvania
I501	Lamp	GE1869	GE
R501	Resistor, Carbon, 51 ±5%, $\frac{1}{2}$w	RC20GF510J	
R502	Resistor, Carbon, 100M ±5%, $\frac{1}{2}$w	RC20GF104J	
R503	Resistor, Carbon, 10K ±5%, $\frac{1}{2}$w	RC20GF103J	
R504	Resistor, Carbon, 4.7K ±5%, $\frac{1}{2}$w	RC20GF472J	
R505	Resistor, Carbon, 2.7K ±5%, $\frac{1}{2}$w	RC20GF272J	
R506,507	Resistor, Film, 3.92K ±1%, $\frac{1}{2}$w	RN60D3921F	
R508,509	Resistor, Film, 1.58K ±1%, $\frac{1}{2}$w	RN60D1581F	
R510	Resistor, Carbon, 470 ±5%, $\frac{1}{2}$w	RC20GF471J	
R511	Not Used		
R512	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R513	Resistor, Carbon, 1.8K ±5%, $\frac{1}{2}$w	RC20GF182J	
R514	Resistor, Carbon, 4.7K	RC20GF472J	
R515	Resistor, Carbon, 10K	RC20GF103J	
R516	Not Used		
R517	Resistor, Variable, Carbon 100	FR101U	Allen-Bradley
R518	Resistor, Variable, Carbon 250	FR251U	Allen-Bradley
R519	Not Used		
R520	Resistor, Variable, Carbon 10K	FR103U	Allen-Bradley
R521	Not Used		
R522	Resistor, Carbon, 4.7K ±5%, $\frac{1}{2}$w	RC20GF472J	
Z501	Grommet, Rubber .312"	Z231	Minor Rubber

Figure 6-7. Audio and Level Control (P.C. Assembly 500A) Parts List

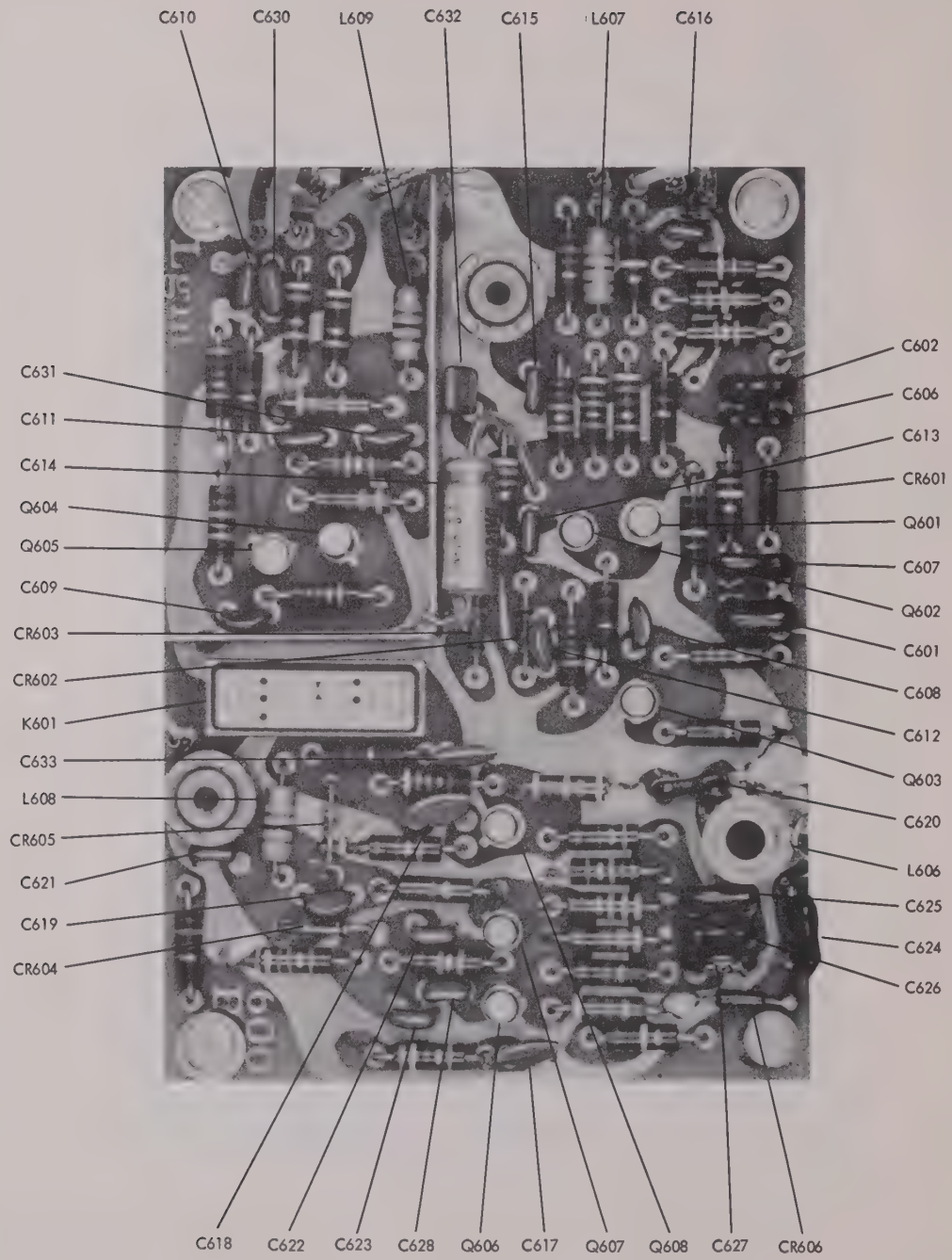


Figure 6-8. Main Oscillator, HF/VHF Circuits (P.C. Assembly 600A) Parts Location (Sheet 1)

Circuit Designation	Description	Part No.	Manufacturer
C601	Capacitor, 820 pf ±5% Mica	DM15-821J	CD
C602	Capacitor, 10 pf ±5% Mica	DM15-100J	CD
C603-605	Not Used		
C606,607	Capacitor, 100 pf ±5% Mica	DM15-101J	CD
C608,609	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C610	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C611,612	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C613	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C614	Capacitor, 25 uf/25v Electrolytic	30D-TE-1207	Sprague
C615,616	Capacitor, .1 uf/100v	8131-100-651-104M	Sprague
C617,618	Capacitor, .001 uf/1Kv ±10% Ceramic	CE102	Centralab
C619	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C620	Capacitor, 100 pf ±5% Mica	DM15-101J	CD
C621-623	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C624	Capacitor, 3 pf ±5% Mica	DM15-030J	CD
C625	Capacitor, 100 pf ±5% Mica	DM15-101J	CD
C626	Capacitor, 10 pf ±5% Mica	DM15-330J	CD
C627	Capacitor, 33 pf ±5% Mica	DM15-330J	CD
C628	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C629	Not Used		
C630,631	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C632	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C633	Capacitor, .001 uf/1 Kv ±10% Ceramic	CE102	Centralab
CR601	Diode, Varactor	MV1620	Motorola
CR602-605	Diode	1N82AG	Sylvania
CR606	Diode, Varactor	MV1620	Motorola
K601	Relay, Reed	W104 MPCX-2	Magnecraft
L606	Coil, Solenoid	1010B	North Hills
L607-609	Coil, RF 100 uh	2307-104	Delevan
Q601	Transistor (FET)	MFE3007	Motorola
Q602	Transistor	2N706	Motorola
Q603	Transistor	2N2857	RCA
Q604,605	Transistor	2N709	Motorola
Q606	Transistor	2N2857	RCA
Q607	Transistor	2N706	Motorola
Q608	Transistor	2N2857	RCA

Figure 6-8. Main Oscillator, HF/VHF Circuits (P.C. Assembly 600A)
Parts List (Sheet 1)

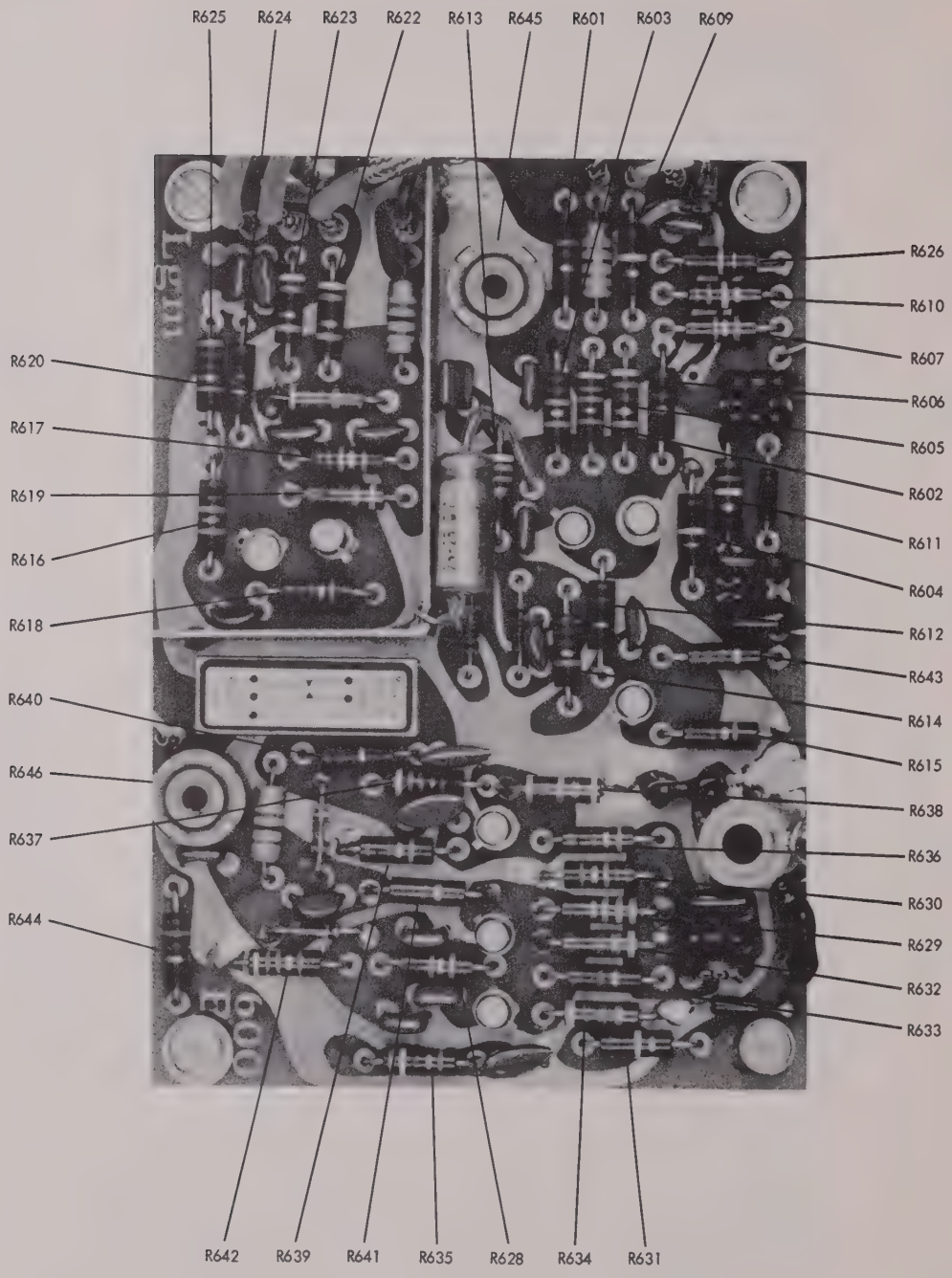


Figure 6-8. Main Oscillator, HF/VHF Circuits (P.C. Assembly 600A) Parts Location (Sheet 2)

Circuit Designation	Description	Part No.	Manufacturer
R601	Resistor, Carbon, 2.7K ±5%, ½w	RC20GF272J	
R602	Resistor, Carbon, 47K ±5%, ½w	RC20GF473J	
R603	Resistor, Carbon, 22K ±5%, ½w	RC20GF223J	
R604	Resistor, Carbon, 100K ±5%, ½w	RC20GF104J	
R605	Resistor, Carbon, 470 ±5%, ½w	RC20GF471J	
R606	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R607	Resistor, Carbon, 10K ±5%, ½w	RC20GF103J	
R608	Not Used		
R609	Resistor, Carbon, 100K ±5%, ½w	RC20GF104J	
R610,611	Resistor, Carbon, 270K ±5%, ½w	RC20GF274J	
R612	Resistor, Carbon, 22 ±5%, ½w	RC20GF220J	
R613	Resistor, Carbon, 47K ±5%, ½w	RC20GF473J	
R614	Resistor, Carbon, 220 ±5%, ½w	RC20GF221J	
R615	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R616,617	Resistor, Carbon, 22K ±5%, ½w	RC20GF223J	
R618	Resistor, Carbon, 220 ±5%, ½w	RC20GF221J	
R619	Resistor, Carbon, 100 ±5%, ½w	RC20GF101J	
R620	Resistor, Carbon, 470 ±5%, ½w	RC20GF471J	
R621	Not Used		
R622,623	Resistor, Carbon, 47 ±5%, ½w	RC20GF470J	
R624	Resistor, Carbon, 100 ±5%, ½w	RC20GF101J	
R625	Resistor, Carbon, 820 ±5%, ½w	RC20GF821J	
R626	Resistor, Carbon, 100K ±5%, ½w	RC20GF104J	
R627	Not Used		
R628	Resistor, Carbon, 10K ±5%, ½w	RC20GF103J	
R629	Resistor, Carbon, 33K ±5%, ½w	RC20GF333J	
R630	Resistor, Carbon, 22K ±5%, ½w	RC20GF223J	
R631	Resistor, Carbon, 100K ±5%, ½w	RC20GF104J	
R632,633	Resistor, Carbon, 100 ±5%, ½w	RC20GF101J	
R634	Resistor, Carbon, 470 ±5%, ½w	RC20GF471J	
R635	Resistor, Carbon, 390 ±5%, ½w	RC20GF391J	
R636	Resistor, Carbon, 100 ±5%, ½w	RC20GF101J	
R637,638	Resistor, Carbon, 47K ±5%, ½w	RC20GF473J	
R639	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R640	Resistor, Carbon, 22 ±5%, ½w	RC20GF220J	
R641	Resistor, Carbon, 220 ±5%, ½w	RC20GF221J	
R642	Resistor, Carbon, 47K ±5%, ½w	RC20GF473J	
R643	Resistor, Carbon, 220 ±5%, ½w	RC20GF221J	
R644	Resistor, Carbon, 2.7K ±5%, ½w	RC20GF272J	
R645,646	Resistor, Variable, 250	FR251U	Allen-Bradley

Figure 6-8. Main Oscillator, HF/VHF Circuits (P.C. Assembly 600A) Parts List (Sheet 2)

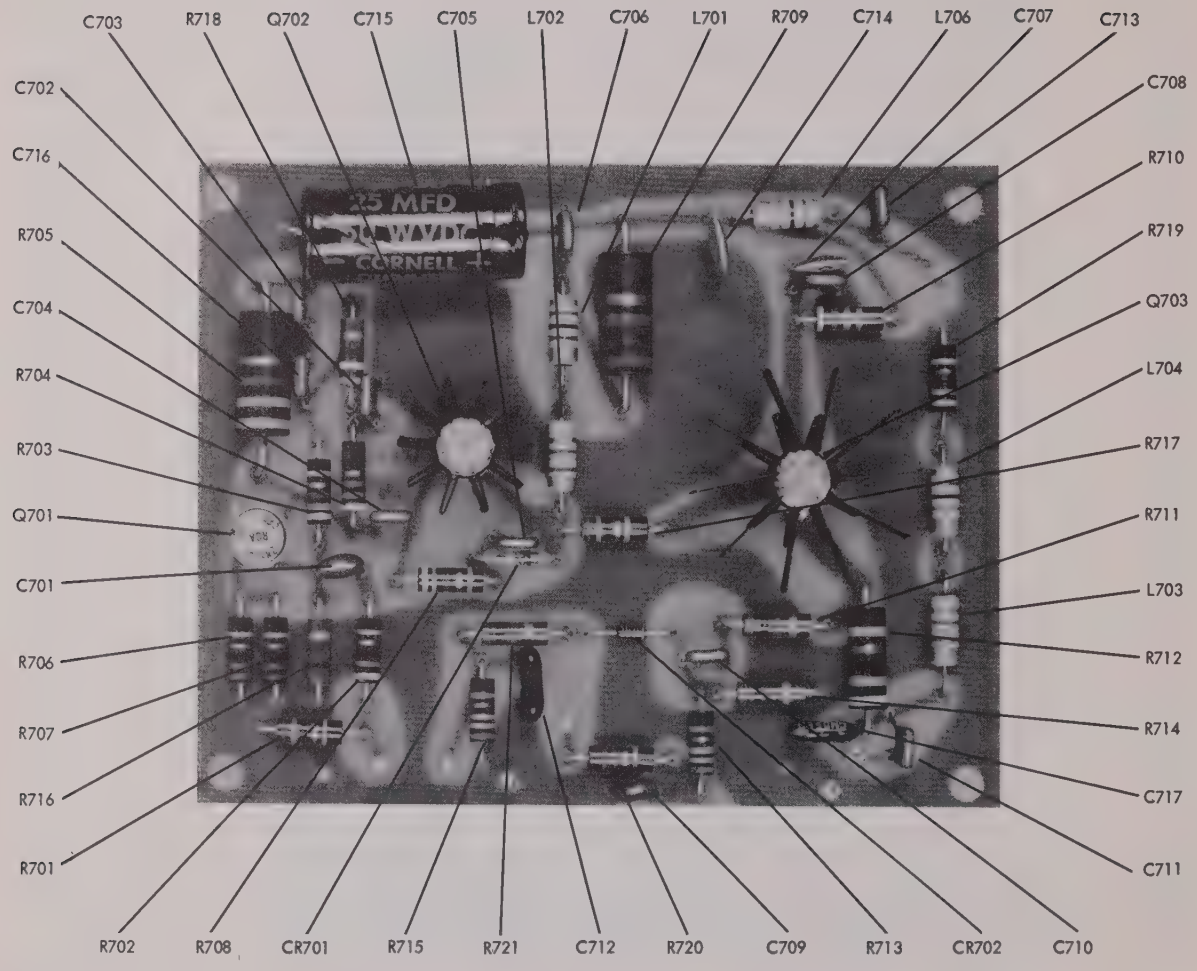


Figure 6-9. High Level RF Amplifier Circuits (P.C. Assembly 700A)
Parts Location

Circuit Designation	Description	Part No.	Manufacturer
C701	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C702-706	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C707	Capacitor, .01 uf/50v Ceramic	CK103	Centralab
C708	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C709	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
C710,711	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C712	Capacitor, 470 pf ±5% Mica	DM15-471J	CD
C713	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C714	Capacitor, .01 uf/50v Ceramic	CK103	Centralab
C715	Capacitor, 25 uf/50v Electrolytic	BR25-50	CD
C716	Capacitor, .1 uf/100v	8131-100-651-104M	Erie
C717	Capacitor, 20 pf ±5% Mica	DM15-200J	CD
CR701	Diode	1N965A	Motorola
CR702	Diode, Hot Carrier	HP5082-2811	HP
HS701,702	Heatsink	NF207-209	Wakefield
L701	Coil, RF 100 uh	2307-104	Delevan
L702,703	Coil, RF 2.7 mh	2307-275	Delevan
L704,706	Coil, RF 100 uh	2307-104	Delevan
Q701-703	Transistor	2N5109	RCA-
R701	Resistor, Carbon, 68 ±5%, ½w	RC20GF680J	
R702	Resistor, Carbon, 47 ±5%, ½w	RC20GF470J	
R703,704	Resistor, Carbon, 470 ±5%, ½w	RC20GF471J	
R705	Resistor, Carbon, 330 ±5%, ½w	RC20GF331J	
R706,707	Resistor, Carbon, 22 ±5%, ½w	RC20GF220J	
R708	Resistor, Carbon, 470 ±5%, 2w	RC42GF151J	
R709	Resistor, Carbon, 150 ±5%, 2w	RC42GF151J	
R710	Resistor, Carbon, 4.7 ±5%, ½w	RC20GF4R7J	
R711	Resistor, Carbon, 100 ±5%, ½w	RC20GF101J	
R712	Resistor, Carbon, 47 ±5%, 1w	RC32GF470J	
R713	Resistor, Carbon, 33K ±5%, ½w	RC20GF333J	
R714	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R715	Resistor, Carbon, 33K ±5%, ½w	RC20GF333J	
R716	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R717	Resistor, Carbon, 27 ±5%, ½w	RC20GF270J	
R718	Resistor, Carbon, 3.9K ±5%, ½w	RC20GF392J	
R719	Resistor, Carbon, 33 ±5%, ½w	RC20GF330J	
R720	Resistor, Carbon, 5.1K ±5%, ½w	RC20GF512J	
R721	Resistor, Carbon, 120 ±5%, ½w	RC20GF121J	

Figure 6-9. High Level RF Amplifier Circuits (P.C. Assembly 700A) Parts List

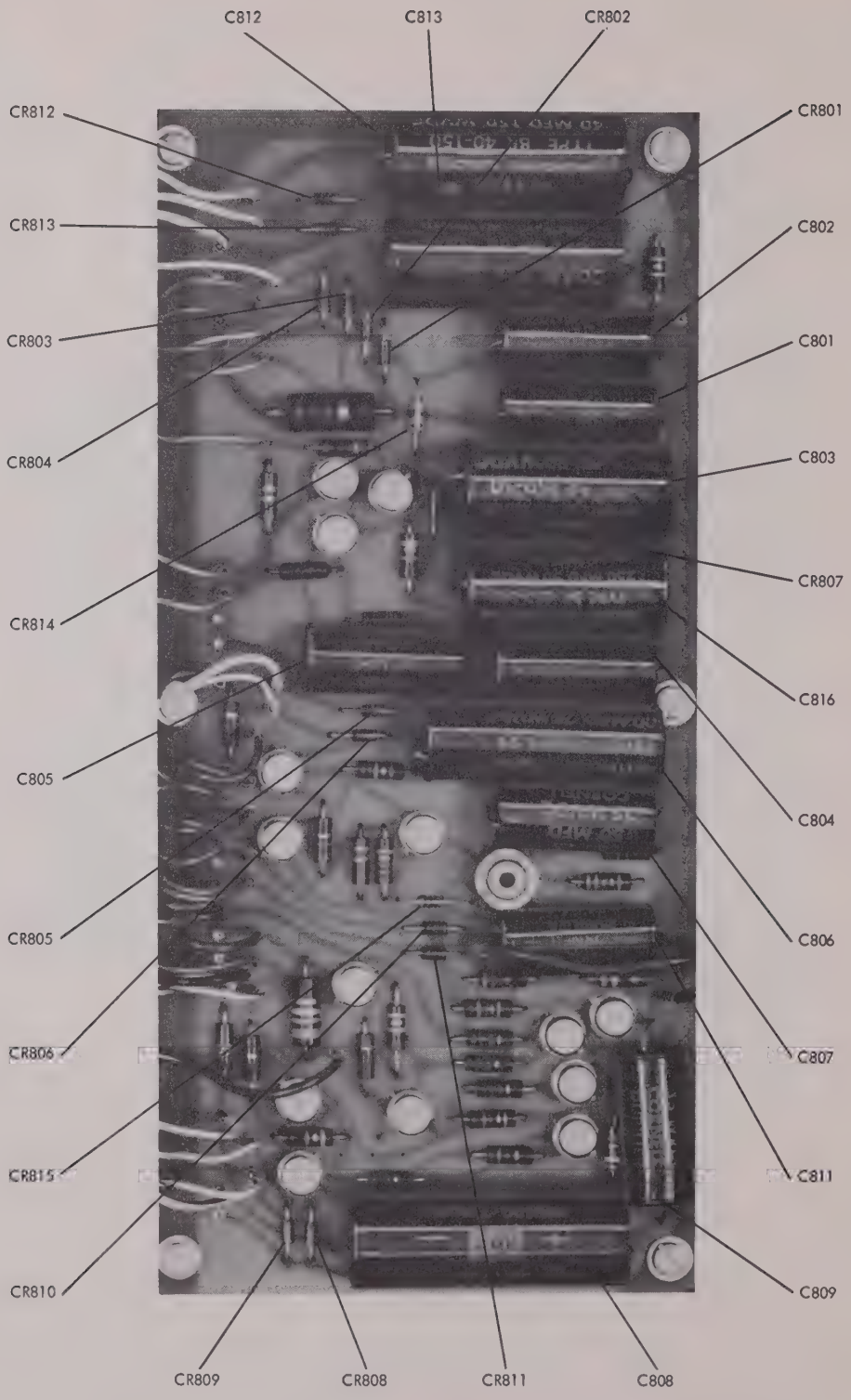


Figure 6-10. Power Supply Circuits (P.C. Assembly 800) Parts Location (Sheet 1)

Circuit Designation	Description	Part No.	Manufacturer
C801	Capacitor, 50 uf/50v, Electrolytic	BR50-50	CD
C802	Capacitor, 50 uf/25v,Electrolytic	BR50-25	CD
C803	Capacitor, 250 uf/50v, Electrolytic	BR250-50	CD
C804,805	Capacitor, 50 uf/50v, Electrolytic	BR50-50	CD
C806	Capacitor, 500 uf/25v, Electrolytic	BR500-25	CD
C807	Capacitor, 50 uf/25v, Electrolytic	BR50-25	CD
C808	Capacitor, 1000 uf/25v, Electrolytic	BR1000-25	CD
C809	Capacitor, 100 uf/15v, Electrolytic	BR100-15	CD
C811	Capacitor, 250 uf/15v, Electrolytic	BR250-15	CD
C812,813	Capacitor, 40 uf/150v, Electrolytic	BR40-150	CD
C816	Capacitor, 250 uf/50v, Electrolytic	BR250-50	CD
C817,818	Capacitor, .02 uf/25v Ceramic	Y5U-203Z	Erie
CR801-811	Diode, Silicon	1N4002	Motorola
CR812,813	Diode, Silicon	1N4004	Motorola
CR814	Diode, Zener Silicon	1N963B	Motorola
CR815	Diode, Zener Silicon	1N753	Motorola
Q801	Transistor, NPN Silicon	2N2101	Motorola
Q803-805	Transistor, NPN Silicon	2N2102	Motorola
Q807,808	Transistor, NPN Silicon	2N2102	Motorola
Q809,810	Transistor, NPN Silicon	2N2905	RCA
Q811,812	Transistor, NPN Silicon	2N2102	Motorola
Q814,815	Transistor, NPN Silicon	2N2905	RCA
Q816,817	Transistor, NPN Silicon	2N2102	Motorola

Figure 6-10. Power Supply Circuits (P.C. Assembly 800)
Parts List (Sheet 1)

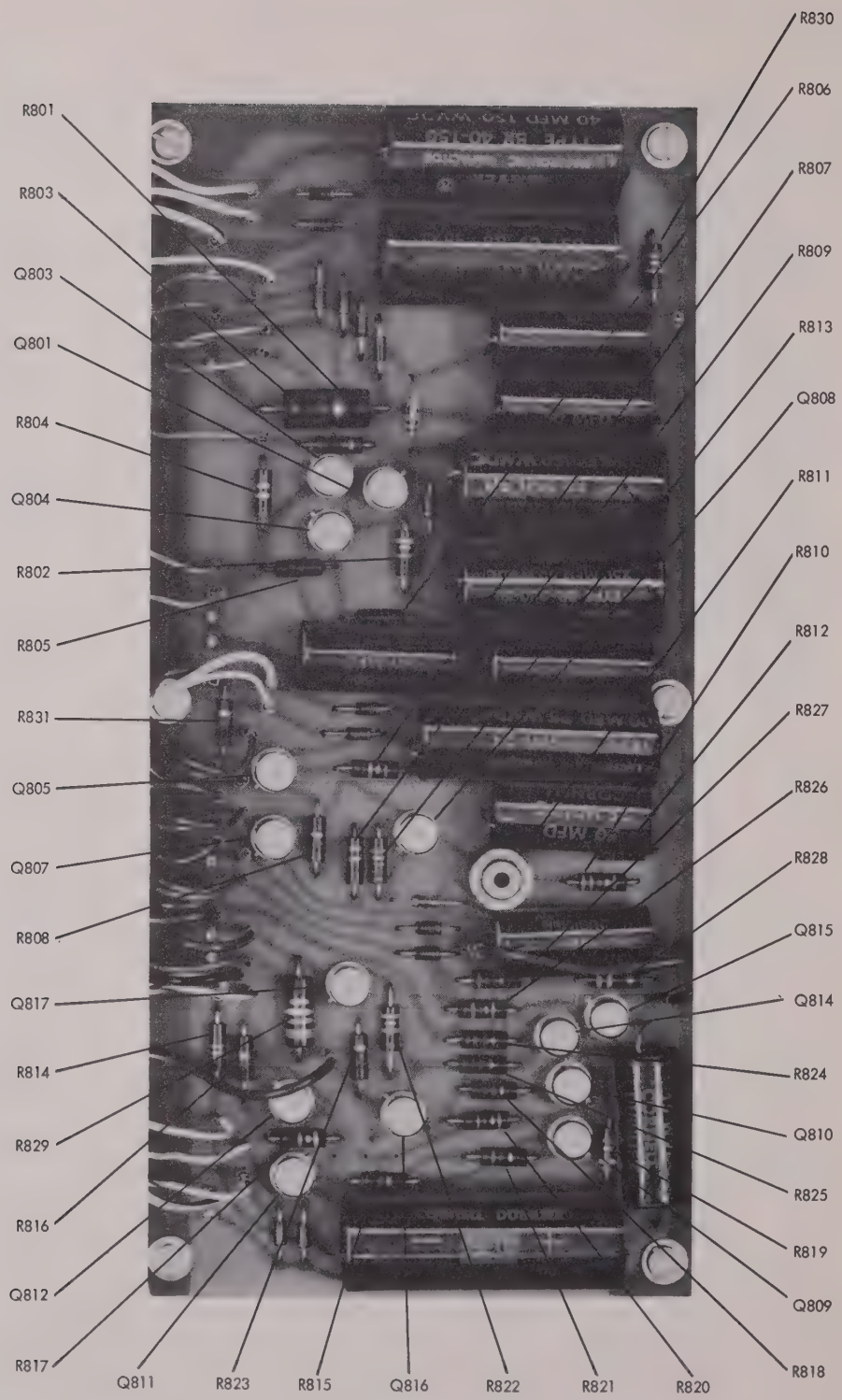


Figure 6-10. Power Supply Circuits (P.C. Assembly 800)
Parts Location (Sheet 2)

Circuit Designation	Description	Part No.	Manufacturer
R801	Resistor, Carbon 1.5K ±5%, 2w	RC42GF152J	
R802	Resistor, Carbon, 10K ±5%, ½w	RC20GF103J	
R803	Resistor, Carbon 1K ±5%, ½w	RC20GF102J	
R804	Resistor, Carbon, 1.0 ±5%, ½w	RC20GF1R0J	
R805	Resistor, Film, 8.2K ±1%, ½w	RN60D1822F	
R806	Resistor, Film, 15K ±1%, ½w	RN60D1502F	
R807	Resistor, Carbon, 22K ±5%, ½w	RC20GF223J	
R808	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R809	Resistor, Carbon, 2 ±5%, ½w	RC20GF2R0J	
R810	Resistor, Carbon, 3.3K ±5%, ½w	RC20GF332J	
R811	Resistor, Carbon, Variable, 5K	FR502-U	Allen-Bradley
R812	Resistor, Carbon, 6.8K ±5%, ½w	RC20GF682J	
R813	Resistor, Carbon, 2.2K ±5%, ½w	RC20GF222J	
R814	Resistor, Carbon, 2.2 ±5%, ½w	RC20GF2R2J	
R815, 816	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R817	Resistor, Carbon, 10K ±5%, ½w	RC20GF103J	
R818	Resistor, Carbon 5.1K ±5%, ½w	RC20GF512J	
R819	Resistor, Carbon, 3.9K ±5%, ½w	RC20GF392J	
R820	Resistor, Carbon, 6.8K ±5%, ½w	RC20GF682J	
R821	Resistor, Carbon, 2.7K ±5%, ½w	RC20GF272J	
R822	Resistor, Carbon, 10K ±5%, ½w	RC20GF103J	
R823	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	
R824	Resistor, Carbon, 2.2K ±5%, ½w	RC20GF222J	
R825	Resistor, Carbon, 220 ±5%, ½w	RC20GF221J	
R826	Resistor, Carbon, 1.8K ±5%, ½w	RC20GF182J	
R827	Resistor, Carbon, 8.2K ±5%, ½w	RC20GF822J	
R828	Resistor, Carbon, 3.3K ±5%, ½w	RC20GF332J	
R829	Resistor, Carbon, 100K ±5%, 2w	RC20GF103J	
R831	Resistor, Carbon, 1K ±5%, ½w	RC20GF102J	

Figure 6-10. Power Supply Circuits (P.C. Assembly 800)
Parts List (Sheet 2)

Circuit Designation	Description	Part No.	Manufacturer
C1001	Capacitor, .01 uf/100v	192P10392	Sprague
C1004	Capacitor, 220 pf ±5% Mica	DM15-221J	CD
C1005	Capacitor, .01 uf/50v Ceramic	CK103	Centralab
K1001	Relay	W105MPCX-3	Magnecraft
R1001	Resistor, Carbon, 15K ±5%, $\frac{1}{2}$w	RC20GF153J	
R1003	Resistor, Carbon, 15K ±5%, $\frac{1}{2}$w	RC20GF153J	
R1005	Resistor, Carbon, 39K ±5%, $\frac{1}{2}$w	RC20GF393J	
R1007	Resistor, Carbon, 100 ±5%, $\frac{1}{2}$w	RC20GF101J	
R1008	Resistor, Variable 10K	FR103-U	Allen-Bradley

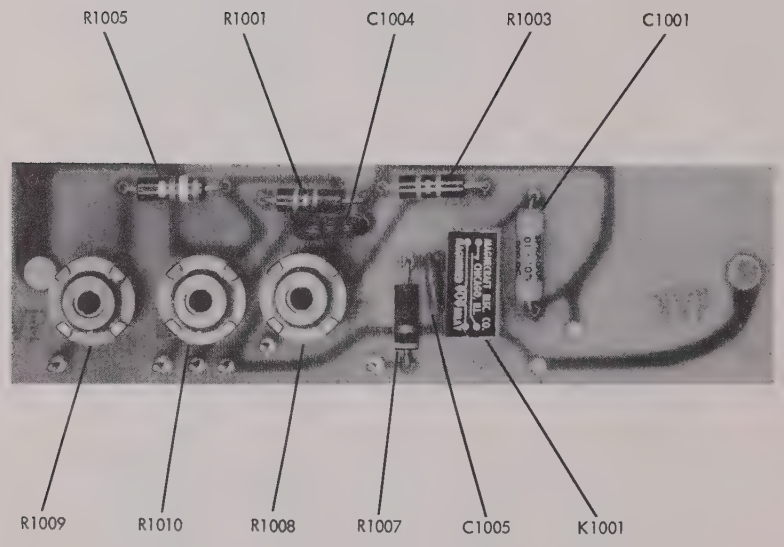


Figure 6-11. Meter and Feedback Control Circuits (P.C. Assembly 1000) Parts Location/Parts List

Circuit Designation	Description	Part No.	Manufacturer
A1101-1103	Integrated Circuit	MC824P	Motorola
R1101-1103	Resistor, Carbon, 1K ±5%, $\frac{1}{2}$w	RC20GF102J	
S1101	Socket, 14-Pin	IC-014ST-7519	

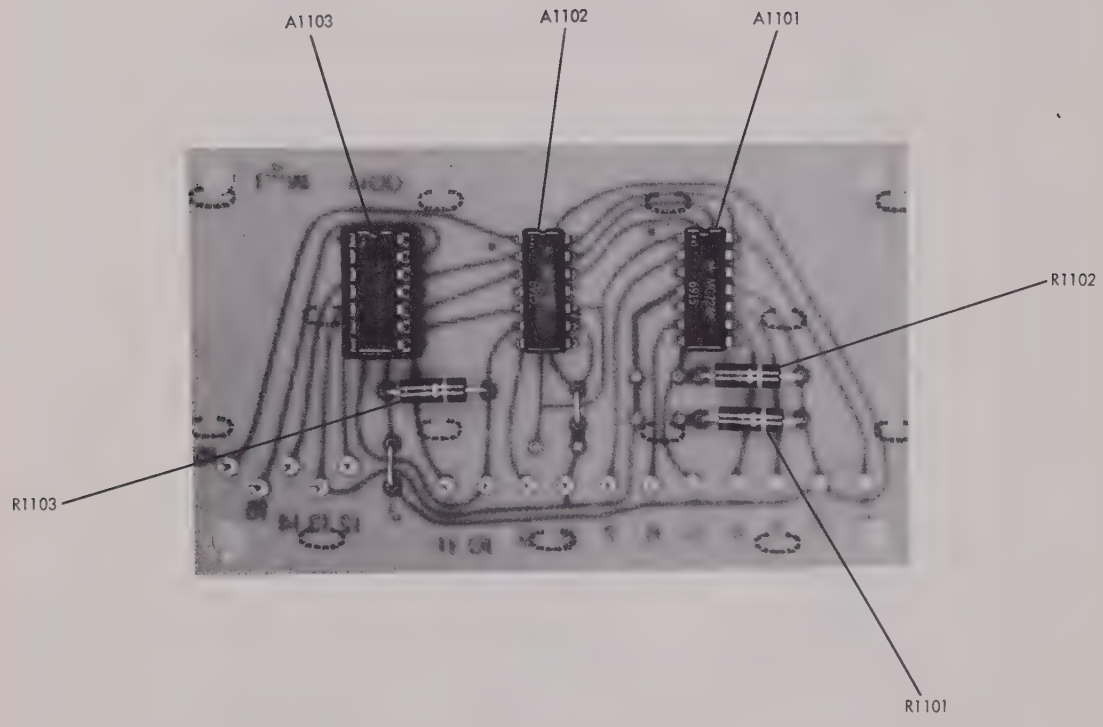


Figure 6-12. Gate Time Logic Circuits (P.C. Assembly 1100) Parts Location/Parts List

Table 6-1. Table of Interconnection Wiring Data

FROM	TO		
P.C. Assy - Pin No.	P.C. Assy/ Ref Sym - Pin No.	Color or Type	Function
100 - 1	600 - 5 (via J1)	RG-58/U	Signal Input
- 2	600 - 6 (via J1)	Shield	Signal Ground
- 3	1100 - 12	RG-174/U	Signal Output
- 4	Coax Shield	Shield	Signal Ground
- 5	FT - 2 (Top)	WH/BLK/RD	5.2 v
200 - 1	G201 - Gnd Lug	BLK	MHz - KHz Ground
- 2	S1 - D1	WH/OR	KHz
- 3	S1 - D6	OR	MHz
- 4	S1 - E1	WH/BLK	Dec. Pt. V1
- 5	S1 - E6	WH/GRY	Dec. Pt. V2
- 6	300 - 3	WH	Storage Reset
- 7	300 - 9	RG-174/U	Counter Input
- 8	300 - 1	BRN	Storage Load
- 9	G201 - Gnd Lug	BLK	B-1
- 10	300 - 2	BLU	Counter Reset
- 11	800 - 2	#18 RD	+3.6 v
- 12	S1 - E4	GRY	Dec. Pt. V3
- 13	N/C		
- 14	N/C		
- 15	800 - 6	WH/BLK/OR	+179 v
G201	200 - 9		Ground
	200 - 1		
	Shield	RG-174/U	
300 - 1	200 - 8	BRN	Storage Load
- 2	200 - 10	BLU	Counter Reset
- 3	200 - 6	WH	Storage Reset
- 4	N/C		
- 5	1100 - G301 (Gnd Lug)	BLK	Gnd Tie Point
- 6	S01	RG-174/U	Signal Input
- 7	1100 - 15	RG-174/U	Limiter Output
- 8	FT - 1 (Top)	#18 RD	+3.6 v
- 9	200 - 7	RG-174/U	To Main Counter
- 10	1100 - 14	WH/YEL	Count Gate
- 11	1100 - 1	BRN	Binary Time Base Input
- 12	1100 - 11	WH/BRN	Gate Width Control
- 13	1100 - 9	WH	Binary Time Base Out
- 14	1100 - 16	WH/BLU	Binary Time Base Out
- 15	1100 - 3	OR	Decade Time Base
- 16	1100 - 6	BLU	Decade Time Base
- 17	1100 - 7	Y10	Decade Time Base
400 - 1	J3	RG-174/U	RF In (from Osc)
- 2	Shield	Shield	Ground
- 3	FT - 10 (Top)	WH/OR	Relay Control (28 v Switched)
- 4	Shield	Shield	Ground
- 5	700 - 2	RG-174/U	RF Out (to RF Ampl)
- 6	FT - 9 (Top)	RD	+12 v
- 7	500 - 3	WH	Modulation & ALC

Table 6-1. Table of Interconnection Wiring Data (Cont)

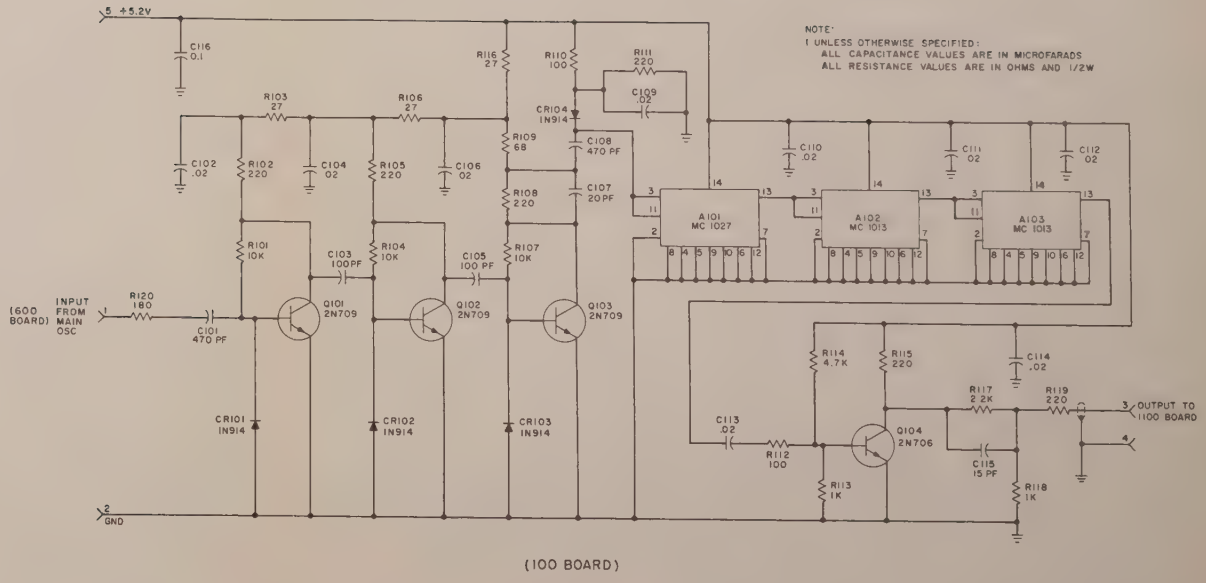
FROM	TO		
P.C. Assy - Pin No.	P.C. Assy/ Ref Sym - Pin No.	Color or Type	Function
500 - 1	S2A - Arm	BRN	Wien Bridge Network
- 2	S2C - 2	WH/YEL	Audio Out
- 3	400 - 7	WH	ALC Out to Modulator
- 4	R201 - Arm	WH/BLU	RF Level Control
- 5	800 - 3	RD	+12 v
- 6	R021-1	WH/GRN	RF Level Control
- 7	800 - 5	V10	-12 v
- 8	1000 - 3	#22 Shielded	ALC In
- 9	M2 (+)	WH/V10	Modulation Meter
- 10	R019 - Arm	WH/GRY	Modulation Depth Control
- 11	M2 (-)	BLK	Ground
- 12	J5	YEL	Ext. Mod.
- 13	S2C - 1	WH/YEL	Ext. Mod.
- 14	R021 - 3	BLU	RF Level Control
- 15	S2A - 2	WH/BRN	Wien Bridge Network
- 16	S2A - 3	WH/BRN	
- 17	S2A - 3	WH/GRN	
- 18	S2B - 2	WH/GRN	
- 19	S2B - Arm	GRN	
-20	Shield	Shield	Ground
600 - 1	J3		To Modulator
- 2	Ground	Shield	Ground
- 3	J2		Uncal. RF
- 4	Ground	Shield	Ground
- 5	J1		Digital Circuitry
- 6	Ground	Shield	Ground
- 7	N/C		
- 8	FT - 7 (Top)	RF	
- 9	FT - 5 (Top)	WH/RED	+12 v Switched
- 10	FT - 3 (Top)	YEL	Freq. Shift
- 11	FT - 4 (Top)	#22 Shielded	Fine Tune
- 12	Ground	Shield	
- 13	N/C		
- 14	N/C		
- 15	FT - 6 (Top)	WH/RD	+12 v Switched
C24, L6	C05A	#20 Bus	
	C05B	#20 Bus	
	C05C	#20 Bus	
	C05D	$\frac{1}{4}$" Braid Shield	
700 - 1	Shield	Shield	Ground
- 2	400 - 5	RG-174/U	RF In
- 3	1000 - 8	#22 Shielded	(ALC) Detected RF
- 4	Shield	Shield	Ground
- 5	FT - 12 (Top)	V10	-12 v

Table 6-1. Table of Interconnection Wiring Data (Cont)

FROM	TO		
P.C. Assy - Pin No.	P.C. Assy/ Ref Sym - Pin No.	Color or Type	Function
700 - 6	Shield	Shield	Ground
- 7	J4	RG-174/U	RF Out to Atten.
- 8	FT - 13 (Top)	OR	+28 v
800 - 1	FT - 2 (Bottom)	WH/BLK/RD	+5.2 vdc
- 2	200 - 11 FT - 1 (Bottom)	#18 RD	+3.6 vdc
- 3	500 - 5, S1 - F (Arm), FT - 7 (Bottom), FT - 10 (Bottom)	RD	+12 v
- 4	FT - 13, S1 - G (Arm)	OR	+28 v
- 5	FT - 12, 500 - 7	V10	-12 v
- 6	200 - 15	WH/BLK/OR	+ 170 v
- 7	T1 - 13	WH/GRN	
- 8	T1 - 15	WH/GRN	
- 9	T1 - 14	WH/BLU	
- 10	Q813 - E	WH/RD	
- 11	Q813 - B	WH/RD	
- 12	G01	BLK	
- 13	T1 - 11	V10	
- 14	Q818 - E		
- 15	T1 - 12	BLU	
- 16	T1 - 10	BLU	
- 17	Q806 - E	RD	
- 18	Q806 - B	RD	
- 19	Q806 - C		
- 20	T1 - 8	WH/OR	
- 21	T1 - 6	WH	
- 22	Q802 - E	OR	
- 23	Q802 - B	OR	
- 24	Q802 - C	OR	
- 25	T1 - 5	GRY	
- 26	T1 - 9	WH/YEL	
- 27	T1 - 17	WH/GRY	
- 28	T1 - 16	WH/GRY	
- 29	G01	BLK	
- 30	C010 (+)	#18 RD	
- 31	Q818 - B	#18 RD	
1000 - 1	M1 (+)	GRN	
- 2	S4 (N.O.)	GRY	
- 3	500 - 8	#22 Shielded	
- 4	Ground	Shield	Ground
- 5	M1 (-)	WH	
- 6	FT - 11 (Top)		Bandswitch
- 7	Ground	Shield	Ground
- 8	700 - 3	#22 Shielded	Detector, RF

Table 6-1. Table of Interconnection Wiring Data (Cont)

FROM	TO		
P.C. Assy - Pin No.	P.C. Assy/ Ref Sym - Pin No.	Color or Type	Function
1100 - 1	300 - 11	BRN	Binary Time Base
- 2	S0 - 2	RD	+3.6 v
- 3	300 - 15	OR	Decade Time Base
- 4	FT - 16	YEL	Bandswitch Control
- 5	FT - 15	GRN	Bandswitch Control
- 6	300 - 16	BLV	Decade Time Base
- 7	300 - 17	V10	Decade Time Base
- 8	N/C		
- 9	300 - 13	WH	Binary Time Base
- 10	FT - 14	BLK	Bandswitch Control
- 11	300 - 12	WH/BRN	Gate Width Control
- 12	100 - 3	RG-174/U	Signal In
- 13	G1101		Ground
- 14	300 - 10	WH/YEL	Count Gate
- 15	300 - 7	RG-174/U	Limiter Output
- 16	300 - 14	WH/BLU	Binary Time Base Dividers



(100 BOARD)

Figure 6-13. Prescaler Circuits (P.C. Assembly 100), Schematic Diagram

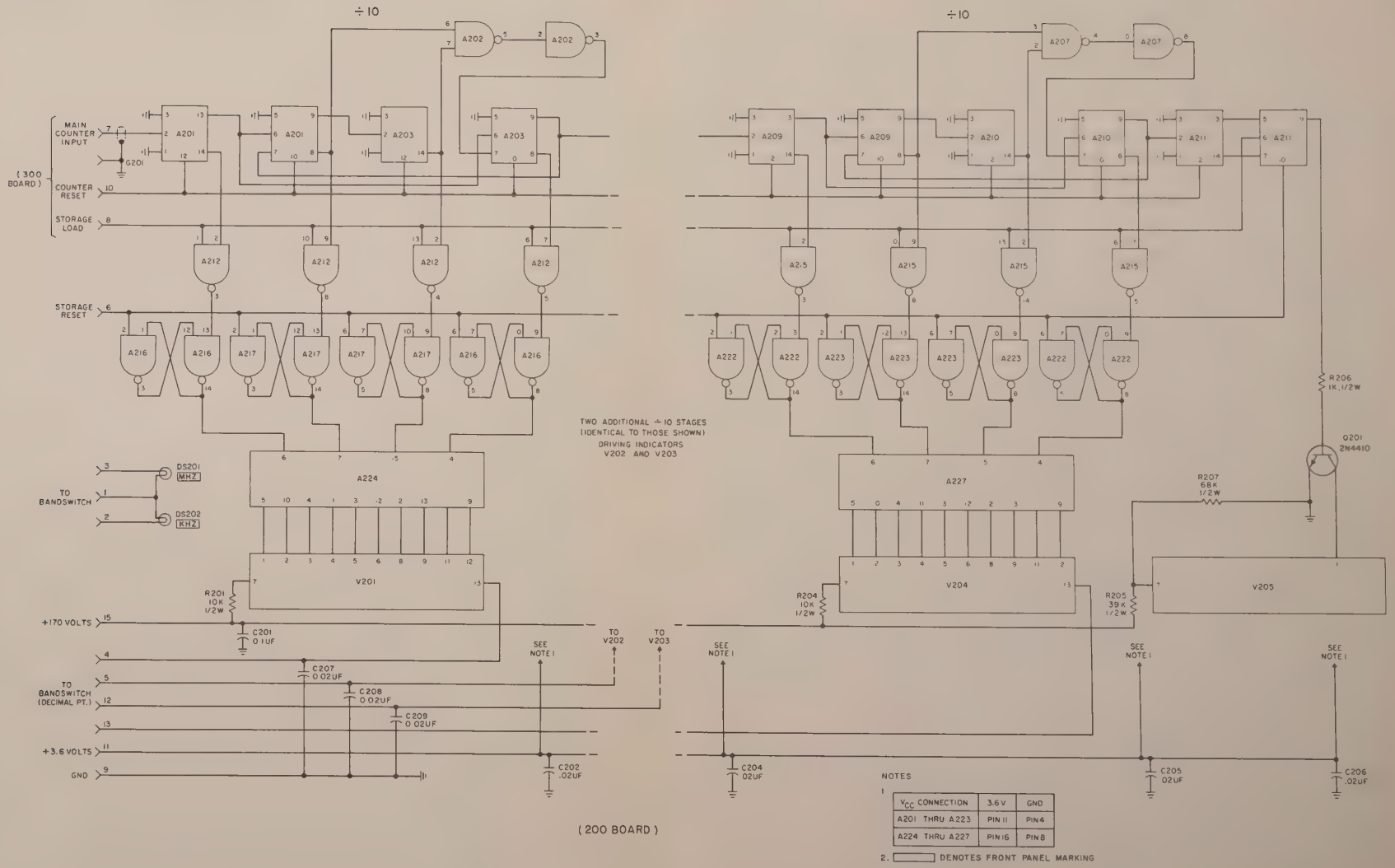


Figure 6-14. Counter, Storage, and Display Circuits (P.C. Assembly 200), Schematic Diagram

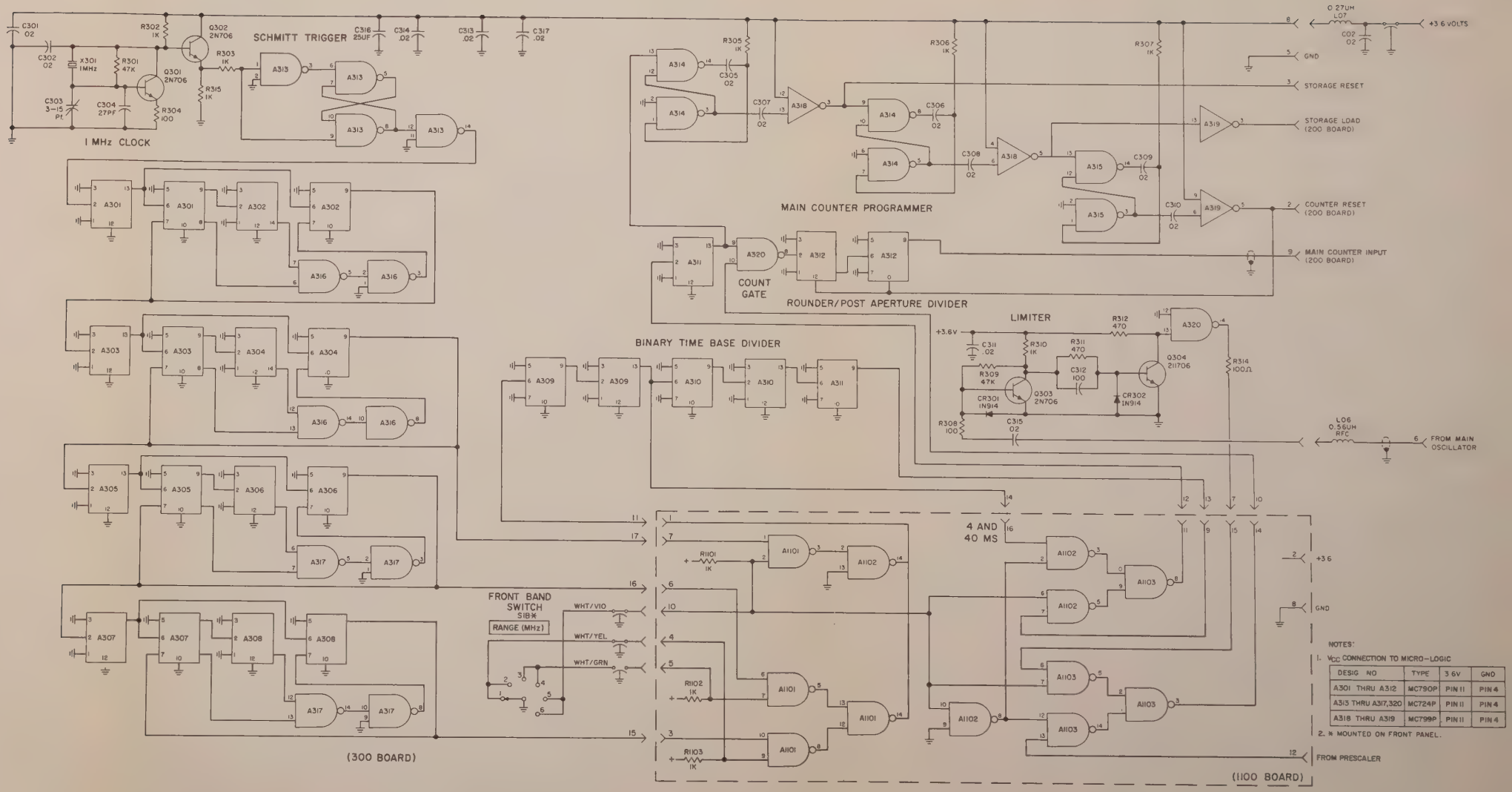


Figure 6-15. Gate Time Logic Circuits (P.C. Assembly 300, 1100), Schematic Diagram

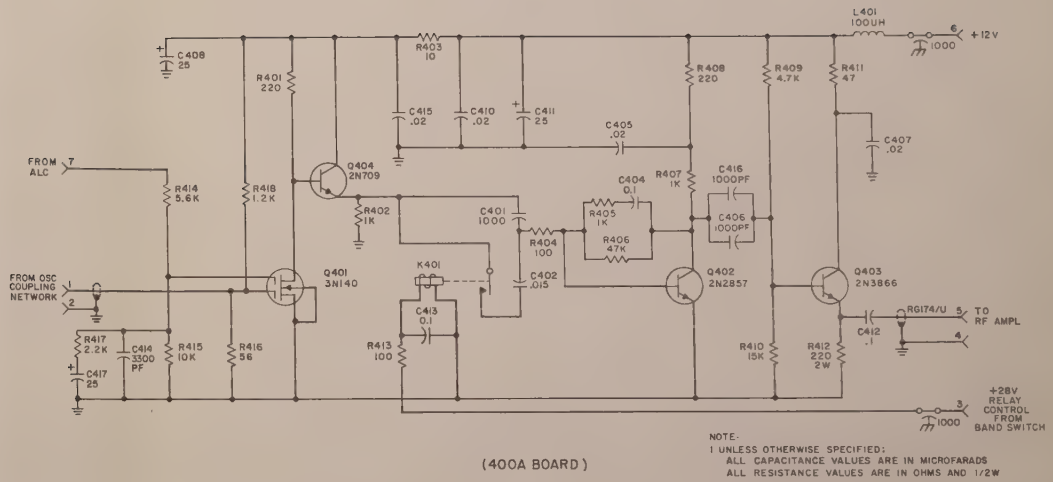


Figure 6-16. Modulation Circuits (P.C. Assembly 400A), Schematic Diagram

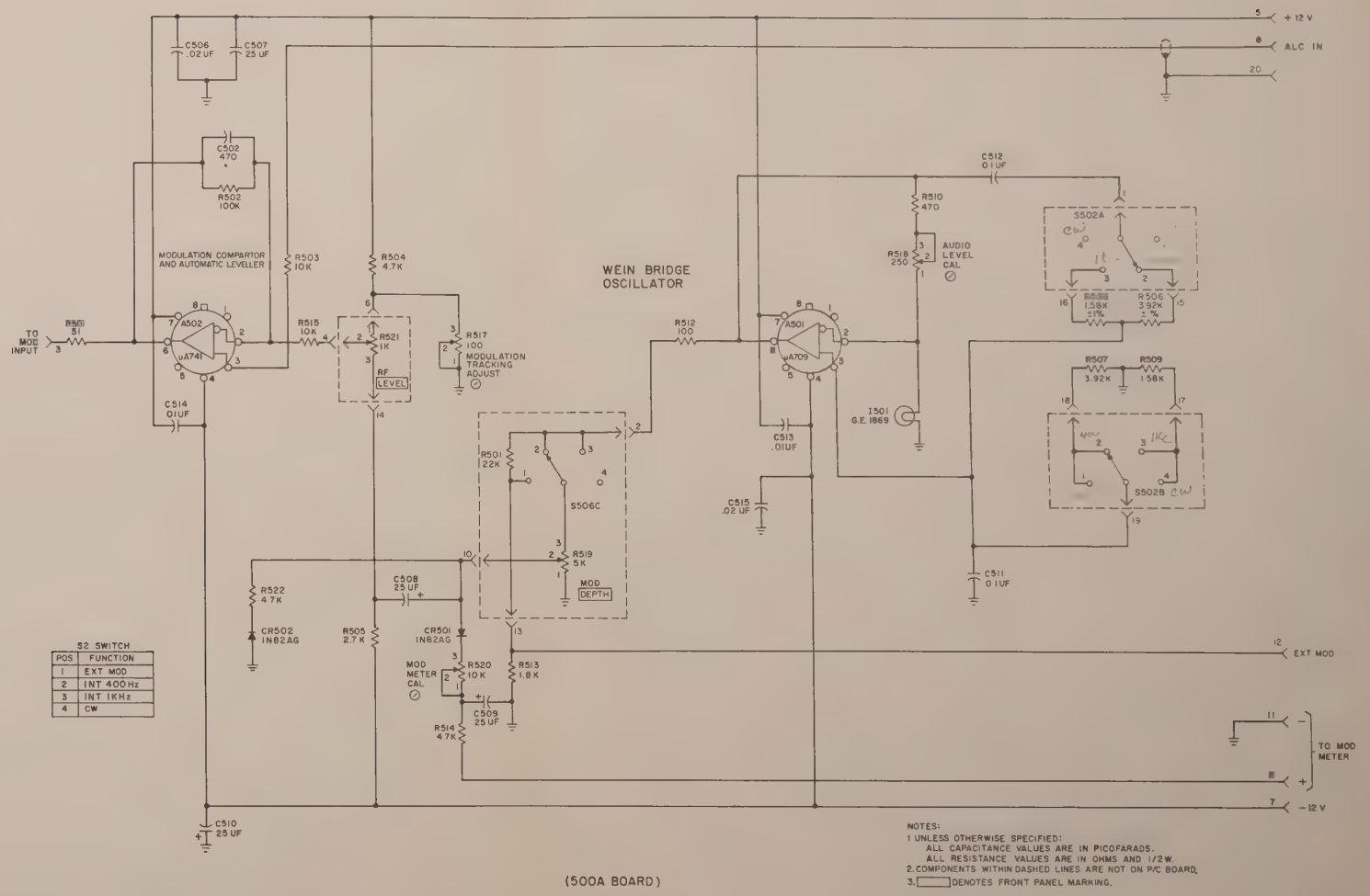


Figure 6-17. Audio and Level Control Circuits (P.C. Assembly 500A), Schematic Diagram

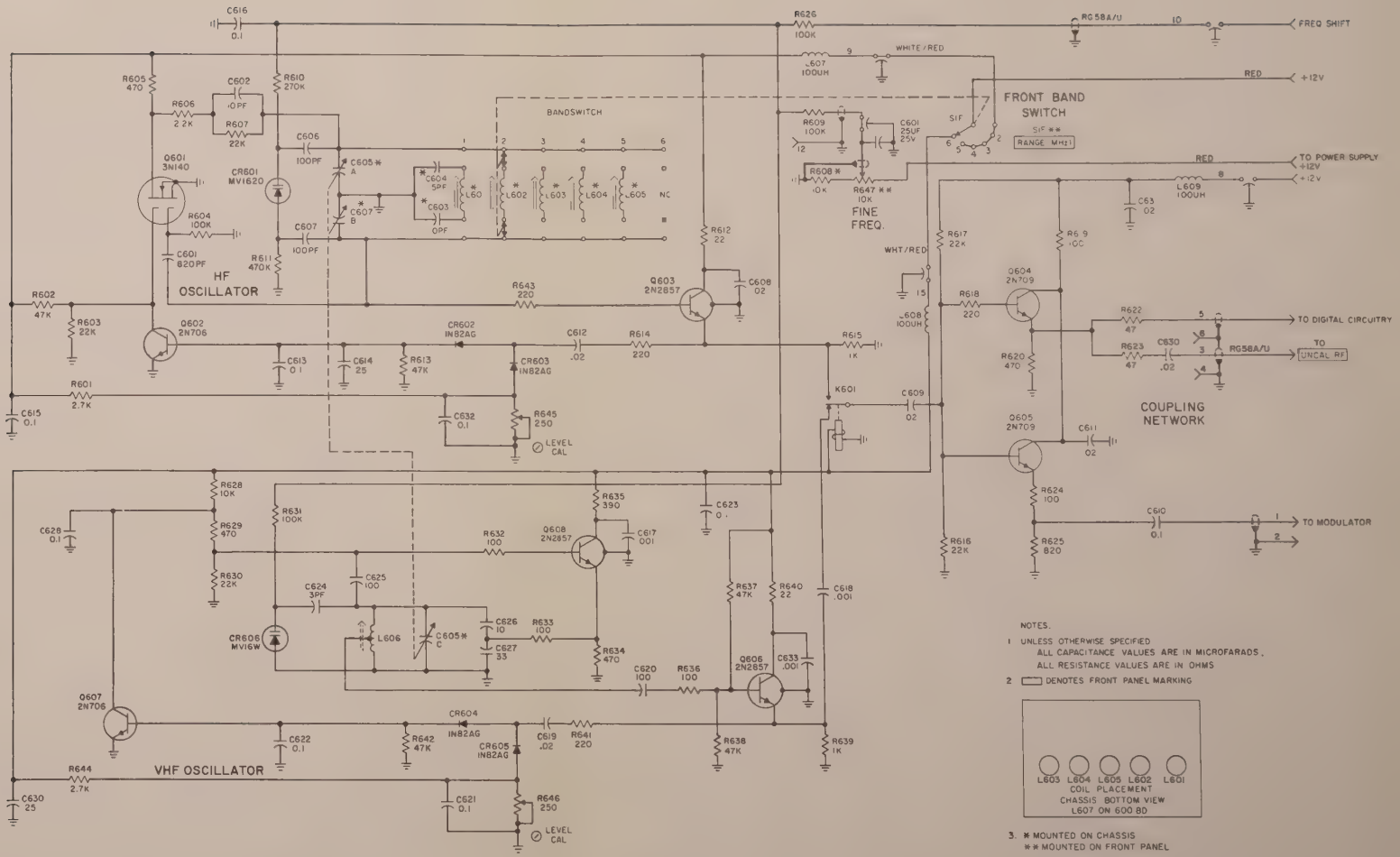


Figure 6-18. Main Oscillator, HF/VHF Circuits (P.C. Assembly 600A), Schematic Diagram

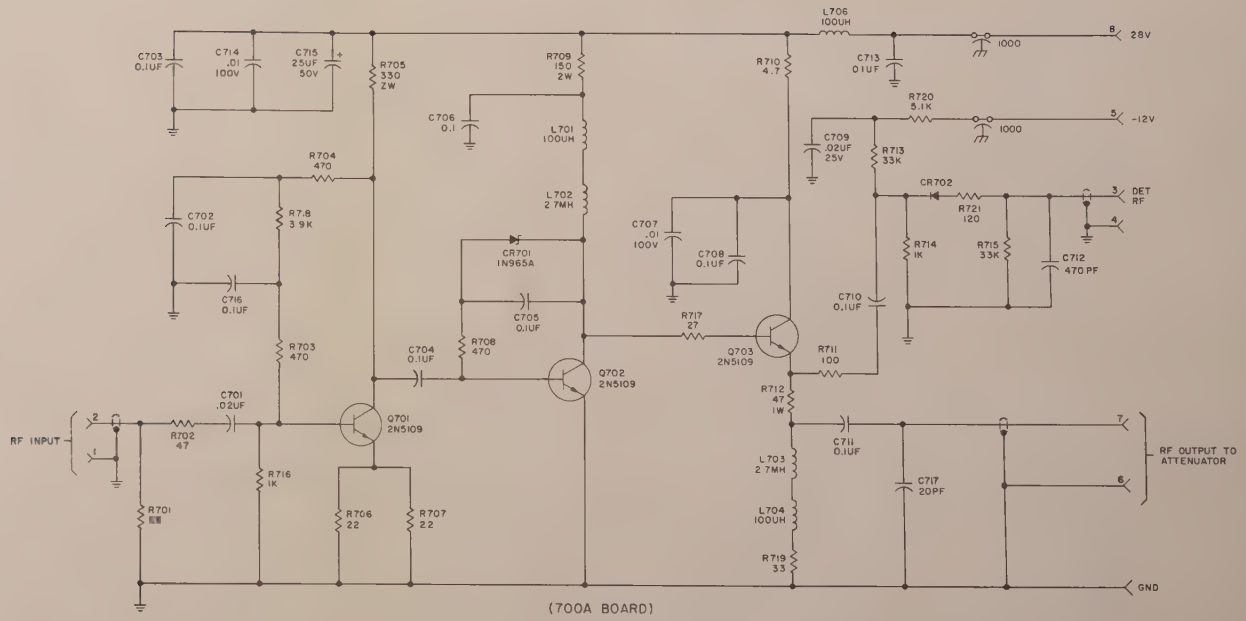


Figure 6-19. High Level RF Amplifier Circuits (P.C. Assembly 700A), Schematic Diagram

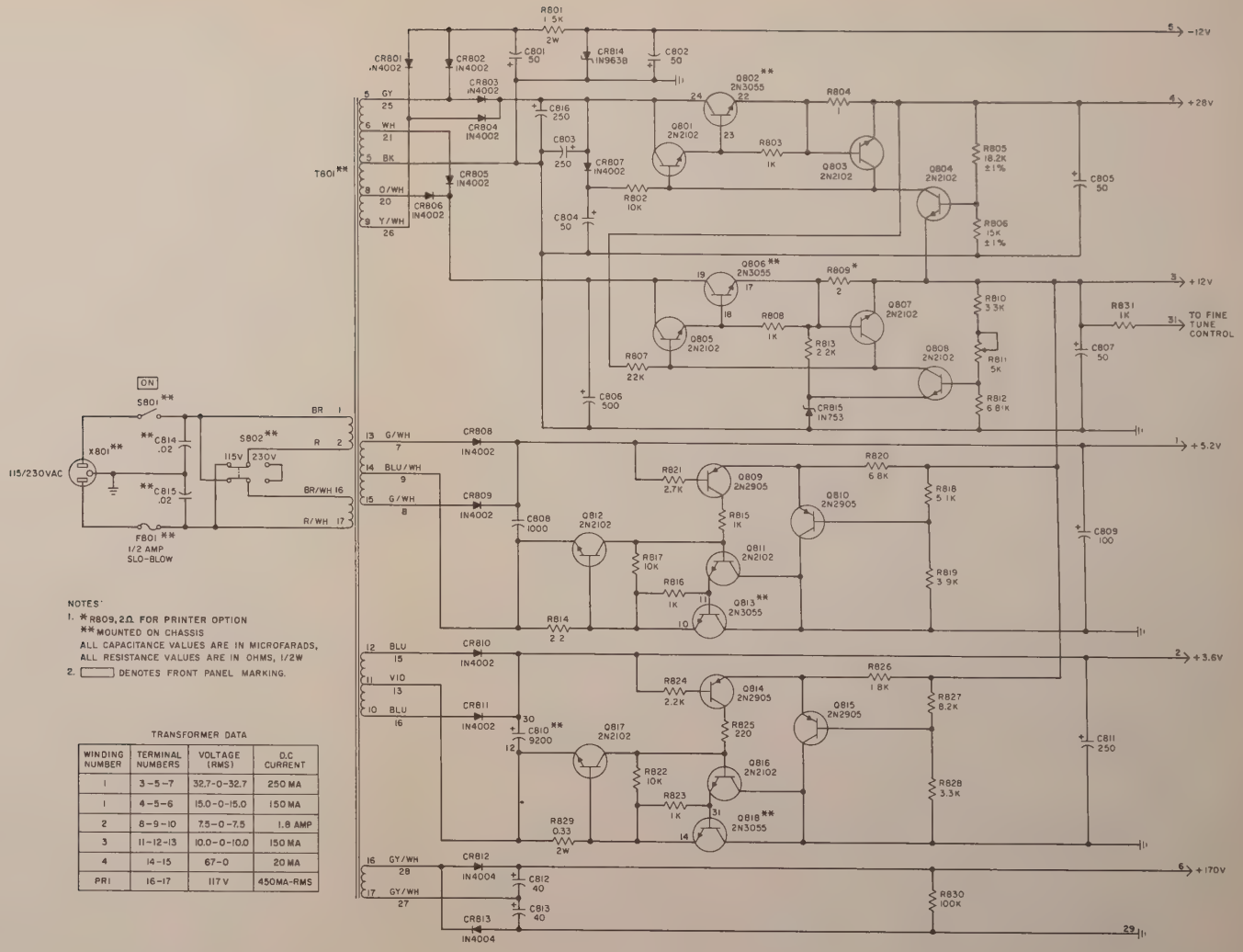


Figure 6-20. Power Supply Circuits (P.C. Assembly 800), Schematic Diagram

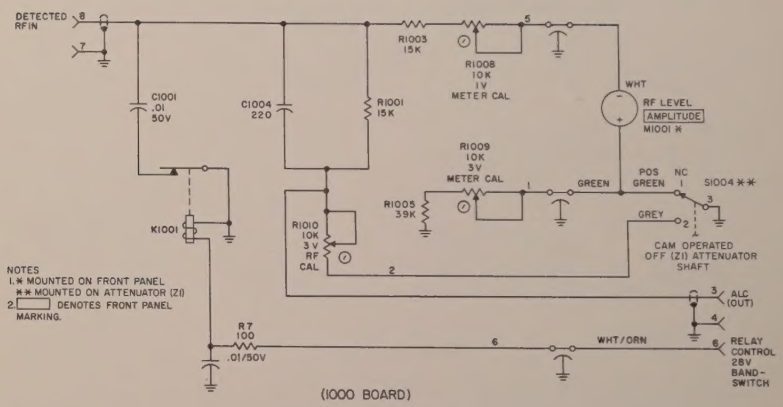


Figure 6-21. Meter and Feedback Control Circuits (P.C. Assembly 1000), Schematic Diagram

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